:5

141899

FINAL

FEASIBILITY STUDY

FOR OPERABLE UNIT II

AUTO ION SITE

KALAMAZOO, MICHIGAN

eder associates
consulting engineers, p.c.

APPENDIX A

SELECTED REFERENCES RELATED TO THE RAILROAD YARD

ROTARY MULTIFORMS, INC.

RITE-O-GRAM

DON'T SAY IT—WRITE IT | WRITE IT RIGHT

TO: Frank Duchamp

FROM: Paul Przeszlo

SUBJECT: Auto Ion Production Painting Control | OUR JOB NO. | DATE OF MEMO 9/7/80

MESSAGE

I have reviewed the files on these sites. Based on the groundwater flow maps for the Auto Ion site, which show radical variations in groundwater flow, I can conclude that the groundwater plumes from all three sites are intermingling. So I think it nearly impossible to clearly distinguish one plume from another

SIGNED [signature]

SENDER—DO NOT WRITE BELOW THIS LINE

REPLY

SIGNED

DATE

ORIGINAL

SENDER — Retain part 2 for your follow-up, send parts 1 and 3 to addressee
RECIPIENT — Retain part 1 and return part 3

GROUNDWATER
TECHNOLOGY, INC.

24168 Haggerty Road, Farmington Hills, MI 48024 U.S.A. (313) 471-2031

TECHNICAL PROPOSAL
FOR
HYDROGEOLOGIC INVESTIGATION
CONSOLIDATED RAIL CORPORATION
BOTSFORD YARD
KALAMAZOO, MICHIGAN
INQUIRY NO. TPM 113088

JANUARY 5, 1989

PREPARED FOR:

T.P. MACASEVICH
CONSOLIDATED RAIL CORPORATION
MATERIALS AND PURCHASING DEPARTMENT
4TH FLOOR, 6 PENN CENTER
PHILADELPHIA, PA 19103

PREPARED BY:

GROUNDWATER TECHNOLOGY, INC.
24168 HAGGERTY ROAD
FARMINGTON HILLS, MICHIGAN 48024

Daniel Strybel
DANIEL STRYBEL
HYDROGEOLOGIST
TERRITORY MANAGER

David E. Arnold
DAVID E. ARNOLD
HYDROGEOLOGIST
DISTRICT MANAGER

P\CRC.DS

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Appendix A - Groundwater Technology, Inc. QA/QC Program

1.0 INTRODUCTION

Groundwater Technology, Inc. (GTI) is please to submit this proposal to Consolidated Rail Corporation (Conrail) to conduct a hydrogeologic investigation at Conrail's Botsford Yard in Kalamazoo, Michigan (see Figure 1). The cause for concern at the Botsford Yard is the presence of phase separated hydrocarbons in the subsurface floating on the water table. In response to the presence of the phase separated hydrocarbons in the subsurface, Conrail installed a recovery system consisting of extraction wells with Filter Scavenger units. GTI was hired by Conrail in the past to inspect and service the Scavenger units and, therefore, is familiar with the problem at the Botsford Yard.

On January 4, 1989, GTI personnel inspected the Botsford Yard. Four extraction wells were discovered at the yard. The two northern most wells, (located near the roundhouse and old fuel pad) approximately four feet of phase separated liquids (as determined with an interface probe) was detected floating on the water table. One well located adjacent to the Kalamazoo River contained over one foot of phase separated liquids.

The objectives of the hydrogeologic investigation are as follows:

- Determine the impact on the groundwater system from the spillage of petroleum products in the vicinity of the roundhouse and old fuel pad.

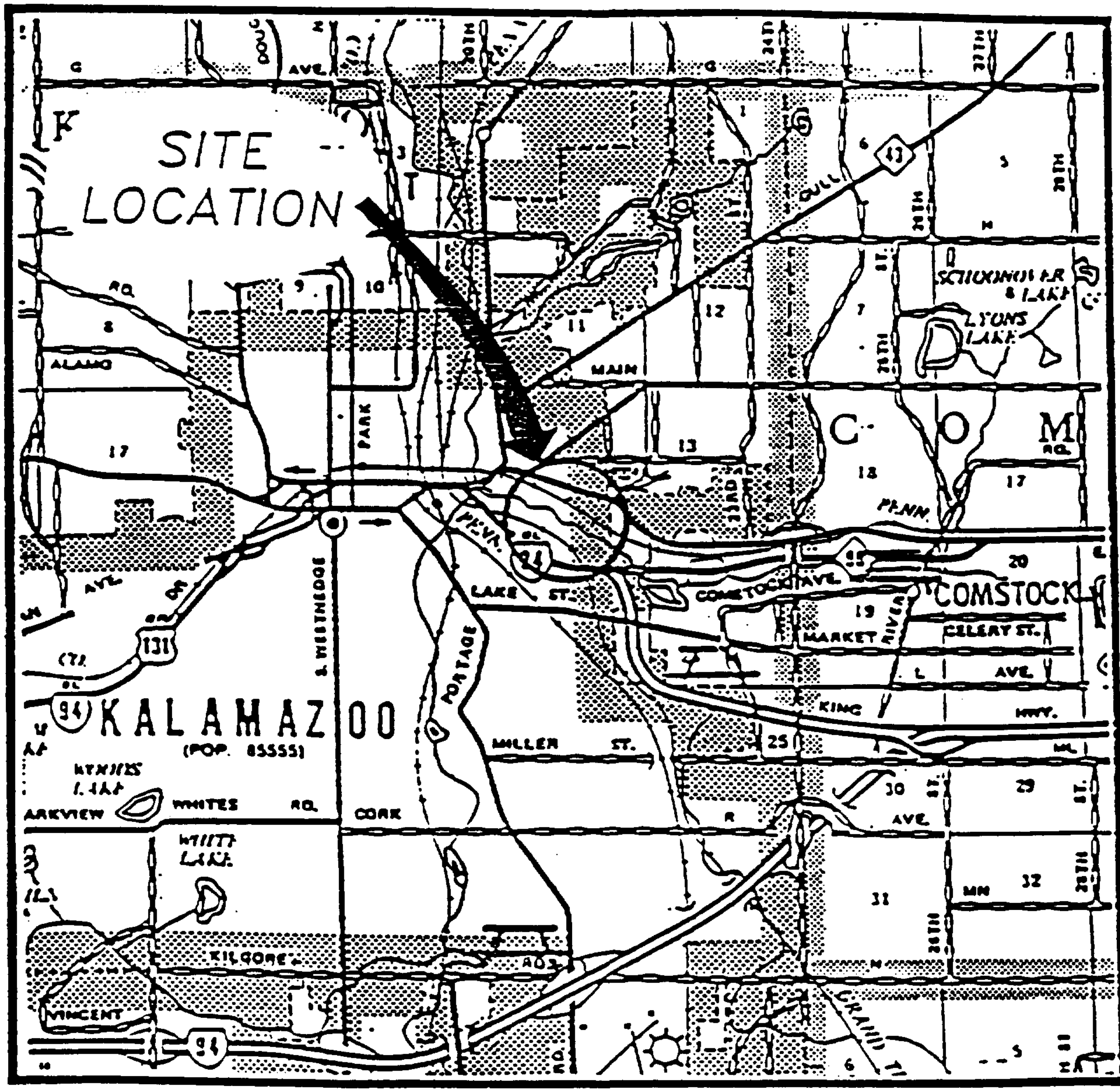
- Investigate the subsurface area adjacent to the Kalamazoo River for the presence of phase separated liquids.

- Investigate migration paths of phase separated liquids towards the sewer line located along Mill Street.

FIGURE 1

SITE LOCATION MAP

CONRAIL BOTSFORD YARD
KALAMAZOO, MICHIGAN



SCALE: 1"=6500'

KALAMAZOO COUNTY

SOURCE: MAPBOOK OF MICHIGAN COUNTIES, MAY 1988

GROUNDWATER TECHNOLOGY, IN

- Evaluate the existing oil recovery system and make recommendations to enhance the system's effectiveness, if needed.

The remaining section of this technical proposal describe the proposed activities to be conducted. The costs to conduct the investigation are presented in a cost proposal (submitted separately to Conrail).

2.0 SUMMARY OF GROUNDWATER TECHNOLOGY, INC. QUALIFICATIONS

As the Statement of Qualifications and Experience demonstrates, GTI is uniquely qualified to fulfill the objectives of the hydrogeologic investigation at the Botsford Yard in Kalamazoo, Michigan. Groundwater Technology, Inc. provides a wide range of environmental services based on the application of various technical disciplines. Involvement on over 4000 contamination remediation projects enables us to conduct assessments and remediations in the most efficient and cost effective manner possible.

The more important qualifications of Groundwater Technology, Inc. relative to this project include:

- GTI has experience working at the Botsford Yard.
- GTI is currently involved in environmental projects for Conrail, including an active project in Indiana that is being administrated from GTI Great Lakes District (office located in Farmington Hills, Michigan).
- GTI has experience in conducting subsurface remediation and assessments in the Kalamazoo, Michigan area.
- GTI has a favorable relationship with Michigan Department of Natural Resources. In particular GTI has considerable success in procuring various permits from the MDNR in a timely manner.

3.0 SCOPE OF WORK

3.1 Quality Assurance/Quality Control

During the drilling of soil borings, monitoring well installation, soil sample collection and analysis, and phase separated liquid sample collection and analysis, GTI's Quality Assurance/Quality control Program will be adhered to. The QA/QC procedures include but are not limited to:

- o Steam cleaning of drilling and soil sampling equipment before and after each borehole is drilled;
- o Chain-of-Custody protocol for laboratory analysis;
- o Proper calibration of field equipment, and;
- o Thoroughly cleaning of water sampling equipment.

A condensed version of GTI's QA/QC program is presented in Appendix A.

3.2 Site Emergency/Site Safety Plan

A Site Emergency Plan will be prepared and will contain the following information:

- o Name, phone number, and location of nearest ambulance, hospital, fire station, police department office, and regulatory agencies, and;
- o Procedures for emergency treatment of injuries.

GTI personnel and representatives will abide by all industry safety practices and all safety requirements specified by Conrail.

3.3 Monitoring Well Installation

Nine soil borings will be drilled with a hollow stem auger. The depth of seven borings is estimated to be twenty-five feet below ground level and the depth of the other two borings is estimated to be fifteen feet. Monitoring wells will be installed in each boring. One well will be installed north of the old fuel pad and will serve as a background well (assuming the direction of groundwater flow is towards the Kalamazoo River). Two wells each will be installed near the roundhouse and the old fuel pad. Two wells will be installed along western edge of the Botsford Yard in order to attempt to determine any migration paths of phase separated liquids towards the sewer line located along Mills Street. Two monitoring wells will be installed adjacent to the Kalamazoo River. The exact locations of the monitoring wells will be determined based upon the locations of utility lines (underground and overhead) and upon approval by Conrail.

The seven wells located near Mill Street, the roadhouse, the old fuel pad, and the most upgradient well will be constructed with fifteen feet of two inch diameter, Schedule 40 PVC screen (.010 slot size) and ten feet of two inch diameter, Schedule 40 PVC riser. The depth to groundwater beneath the Botsford Yard near the roadhouse in January 1989 is approximately 14.5 feet below the surface. The well screen will be installed five feet below the water table and ten feet above it. This interval was chosen to allow for the detection of the phase separated liquids on the water table in lieu of seasonal variations of the water table and the potential for flooding in the area.

On January 4, 1989, the depth to water adjacent to the Kalamazoo River was approximately six feet. The two wells located along the river will be set fifteen feet below the surface. The well screen (same specifications as stated above) will extend from the boring bottom to one foot below the surface to allow for detection of phase separated liquids during flooding episodes. The riser will extend from the one foot below the surface to two feet above the surface. The annular space surrounding these wells will be backfilled as described above.

The annular space surrounding the well screen will be filled with clean silica sand. The annular space surrounding the riser will be filled with clean excavated material or clean sand backfill (if needed) with a bentonite seal placed near the surface. The wells will be set approximately two feet above the ground with steel protective casing (with locking caps) installed around the aboveground riser. Once the installation of the monitoring wells has been completed, the wells will be developed by over pumping or bailing to remove particulate matter and to ensure proper a flow through characteristics of the wells.

3.4 Soil Sample Collection

During the drilling of the soil borings, soil samples will be collected with a split spoon sampler. The soil samples will be placed in airtight glass jars and will be analyzed for headspace organic vapors with an Organic Vapor Analyzer (OVA). The soils encountered during drilling will be described by a GTI geologist and the descriptions will be presented on well logs.

3.5 Fingerprint Analysis of Phase Separated Liquids

Two samples of phase separated liquids will be collected and analyzed. The samples will be collected from selected monitoring wells and will be sent to GTEL Environmental Laboratories. A product identification by modified simulated distillation analysis will be conducted on the samples. This analysis utilizes gas chromatography with flame ionization detection. The samples are fingerprinted by comparing the sample chromatographic scans with different known product scans.

3.6 Hydrogeologic Study

In order to evaluate the hydrogeologic characteristics of the study area, the following tasks will be conducted:

- o Survey of monitoring wells, boring locations, and river level for elevation control;
- o Slug tests on selected wells to determine in situ permeability;
- o Depth to water measurements in each well, and;
- o Preparation of groundwater gradient map.

From the above information, the following aquifer parameters will be determined:

- o Direction of groundwater flow;
- o Hydraulic gradient;
- o Velocity of groundwater flow, and;
- o Areal extent of contaminant plume (based upon available information).

The hydrogeologic study will also consist of obtaining (if available) stream level data for the Kalamazoo River and rainfall information for Kalamazoo. This information can be used to correlate episodes of phase separated liquid discharge into the river (either through the river banks or sewer outfall) with episodes of high river levels and/or large volume rainfall.

3.7 Evaluation of Oil Recovery System

The effectiveness of the existing oil recovery system will be evaluated. The evaluation will consist of an inspection of the Filter Scavenger(s) and the extraction wells. The depth of the wells will also be determined. Upon completion of the initial evaluation and in lieu of information procured from the hydrogeologic study, recommendations to increase the system's effectiveness will be developed. One recommendation will be to conduct pump tests on the existing extraction wells to determine the radial influence on the groundwater system from pumping out of the wells.

3.8 Investigation Report

A report will be prepared that will contain but will not be limited to the following:

- o Description of activities;
- o Site map drawn to scale;
- o Investigation results and conclusions;
- o Well logs;
- o Groundwater gradient map, and;
- o Recommendations for updating the existing oil recovery system (if necessary).

3.9 Optional Tasks

The specifications of the proposed hydrogeologic investigation was based upon the proposal bid package and conversations with Conrail personnel. In addition to the proposed work, GTI submits the following optional tasks for Conrail to consider:

- o Investigation of groundwater for dissolved contaminant constituents, and;
- o Interim, immediate recovery of phase separated hydrocarbons from the surface.

The costs and specifications of the optional tasks can be supplied to Conrail upon request.

4.0 PROJECT MANAGEMENT TEAM

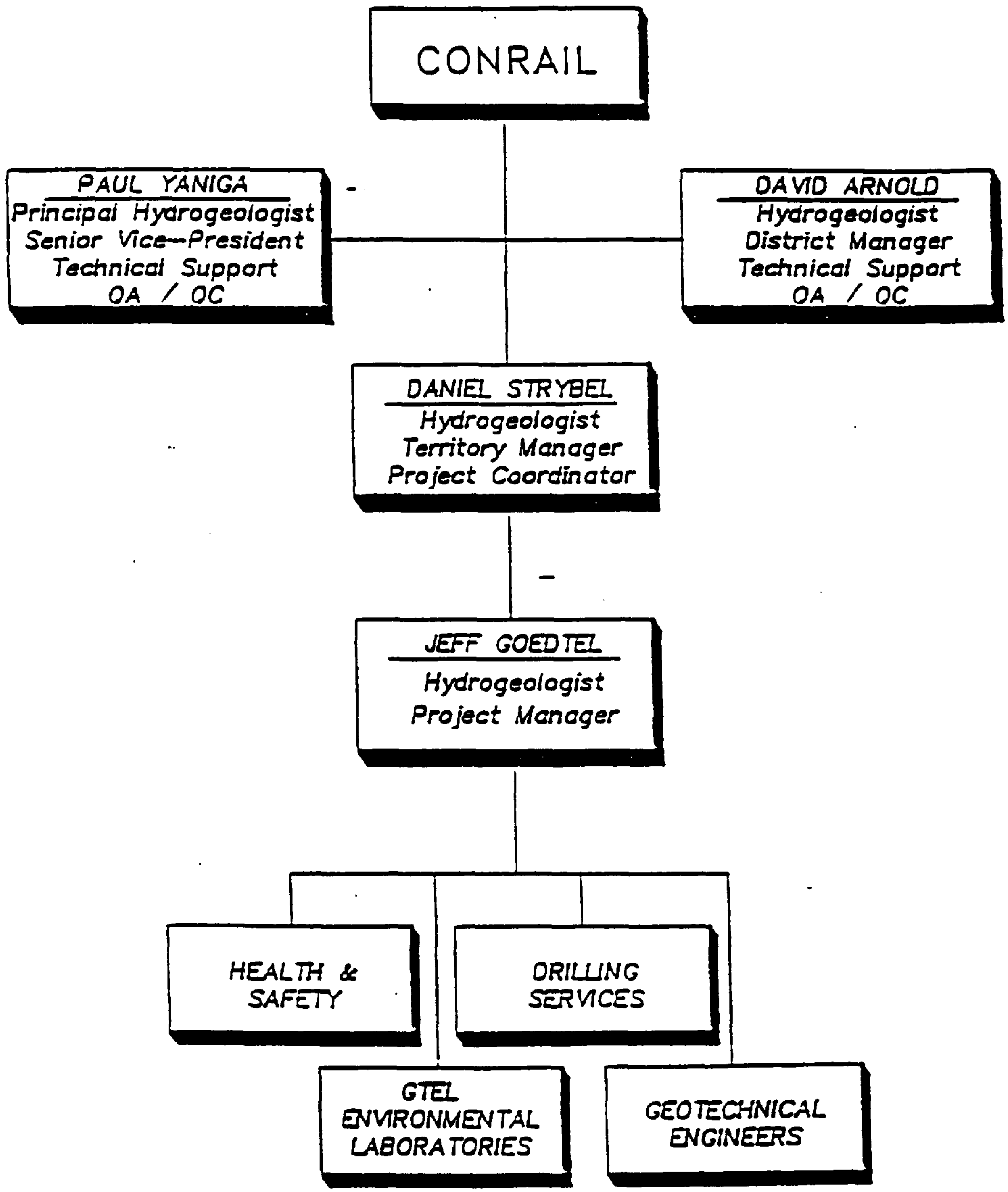
The management of a project of this scope is an essential aspect to the over all success. Groundwater Technology, Inc. realizes this and has assembled a project management team which addresses the technical, logistical, political and regulatory aspects of this project. Another important task of the "team" is to maintain and insure the highest quality of work possible. This is accomplished by the interaction of the field personnel and the coordinators of the various disciplines involved and ultimately with Conrail personnel. The project management team flow chart (see Figure 2) found on the following page illustrates the position and responsibility of the team members.

FIGURE 2

PROJECT MANAGEMENT TEAM

HYDROGEOLOGIC INVESTIGATION

CONRAIL BOTSFORD YARD
KALAMAZOO, MICHIGAN



EAW
DWG.: P1178ORG

GROUNDWATER TECHNOLOGY, INC.

5.0 ESTIMATED PROJECT TIMELINE

GTI will commence work on this project within one week after receiving authorization to do so. The field work is anticipated to be completed in one week. The analysis of the phase separated liquid will be completed in two weeks. The compilation and evaluation of data and the preparation of the report is estimated to take three weeks. The report is estimated to be submitted to Conrail within six weeks after initiating the field work.

APPENDIX A

GROUNDWATER TECHNOLOGY, INC. QA/QC PROGRAM

GROUN
TECHN

GROUNDWATER TECHNOLOGY, INC.
QA/QC PLAN FOR INVESTIGATION
AND SAMPLING OF SOILS AND GROUNDWATER

SECTION	I	INTRODUCTION
	II	GROUNDWATER TECHNOLOGY POLICY STATEMENT
	III	SAMPLING PROCEDURES
	IV	SAMPLE SITE SELECTION
	V	PRELIMINARY PREPARATIONS FOR SAMPLING
	VI	SPECIFIC SAMPLING PROCEDURES
	VII	PRESERVATION METHODS
	VIII	HOLDING TIMES
	IX	MEASURES TO AVOID CROSS-CONTAMINATION OF SAMPLES

NOTE: THE FOLLOWING REPRESENTS A PORTION OF THE COMPLETE GROUNDWATER TECHNOLOGY, INC. QA/QC PLAN. THIS PORTION DEALS WITH SAMPLE COLLECTION AND PREPARATION. A MORE COMPLETE DOCUMENT INCLUDING GROUNDWATER TECHNOLOGY, INC. LABORATORY AND ANALYTICAL PROCEDURES IS AVAILABLE.

2. Any sampling equipment scheduled for use, to be sure that the equipment is clean and in good working order.

3. Instrument calibration.

4. Any back-up systems, to be sure that they are in good working order.

5. Sample bottle supply, to insure that an adequate supply of clean sample bottles is available. Sample bottle preparation is discussed below.

6. Field Blanks (one for each set of samples to be collected will be obtained from the analyzing laboratory, to insure the integrity of the cleaning process and preservation methods. Field blanks will be carried throughout the sampling trip and will be preserved on site at the time the first samples are collected.

7. Field sampling kits, to insure that all items necessary to procure good, properly documented samples are present. A standard sampling kit will contain the following items:

   a. a teflon squirt bottle of 50% hydrochloric acid
   b. a supply of acetone or isopropyl alcohol and hexane
   c. alconox soap
   d. a sufficient supply of distilled water for rinsing
   e. disposable gloves
   f. paper towels
   g. a waterproof pen

h. cloth labels for sample identification
i. a cooler with ice
j. chain-of-custody forms
k. site blanks
l. waste solvent disposal container
m. extra vials and narrow range pH paper to test pH response of water

C. Sample Container Preparation

1. Preparation of water sample containers for volatile organics analysis:

Bottle type - 40 ml glass vials with teflon-lined septum caps (Pierce catalog #13075 or equivalent).

Cleaning procedures:

a. Wash caps, liner, and vials with alconox soap.
b. Rinse liberally with tap water and D.I. water
c. Dry caps and septa in oven at 105 C for no more than 60 minutes. Dry vials in oven at 105 C for a minimum of 60 minutes.
d. Cool in an inverted position in an organic-free atmosphere, and cap immediately.

2. Preparation of soil sample containers for volatile organics analysis:

Bottle type - same as above.

3. Preparation of water sample containers for semi-volatile organics analysis (pesticides, base/neutral and acid extractable organics):

Bottle type - 1 liter or larger narrow-necked glass bottles with teflon-lined caps will be used to collect water samples for organics analysis. Neither plastic bottles nor plastic or rubber lined caps will be used.

Detergent - Alconox soap that has not been stored in plastic containers will be used to clean sample bottles.

Cleaning procedures:

a. Bottles and caps will be washed in hot, soapy water. Brushes with rubber or plastic parts will not be used, and gloves will not be used while washing or rinsing organic bottles.

b. Bottles and caps will be rinsed five times (or until soap suds are gone) with tap water.

c. Each bottle will be rinsed with 10 ml of pesticide-grade acetone, then capped tightly and shaken for approximately 10 seconds.

d. Each bottle will be given a final rinse with organic-free water until no acetone odor remains. This means rinsing at least five times.

e. Bottles will be drained and then capped until used.

VI. SPECIFIC SAMPLING PROCEDURES

A. Sample Integrity

GTL takes responsibility for the integrity of all samples taken for analysis. The sampling procedures described clearly stating integrity requirements, including preservation and chain of custody, are issured to all client and GT offices. Any irregularities upon receipt of samples are immediately relayed to the client or GT office in order that approval to analyze substandard samples becomes the responsibility of the client or the Groundwater Technology Project Manager. Lack of timely response will constitute approval and samples will be analyzed and invoiced. Any irregularities will be clearly stated on the QA statement with the report. GTL will not allow preserved samples to exceed the prescribed holding time. Unacidified samples may require expedited service.

B. Monitor Well Sampling Procedures

Prior to monitor well sampling, the volume of water in wells will be determined. Three to five times the calculated volume of a well will be purged using either a gas-driven centrifugal pump, an electric submersible pump,a pitcher pump, or a teflon bailer. Wells that have slow recovery periods will be bailed dry and then sampled within 24 hours. Stirring up of sediments in wells to be sampled will always be avoided. Once a well has been properly purged, sample collection will follow the procedure outline in part F of this section.

C. Procedure for Sampling Wells with In-place Plumbing
Occasionally, it will be deemed necessary to obtain samples for water quality analysis from wells with in-place plumbing (domestic wells, for example). In this situation, samples will be collected from the most pump-proximal cold water tap available. Any aerators that may be present will be removed. The system will be allowed to flush until water

temperature and/or conductivity has stabilized (at least 30 minutes). Flow will be reduced to 500 ml/minute or less for sample collection. The procedures for sample collection will exactly follow the procedure outlined in Section F of this document from step #2 on.

D. Surface Water Sampling Procedure

Surface water samples will be collected in accordance with the procedure outlined in Section F of this document. Care will be taken not to disturb bottom sediments.

E. Soil Sampling

Soil samples for volatile organics analysis will be collected from the subsurface by using either a split-spoon sampler or a core-barrel sampler. Prior to the sampling trip, soil sample vials and sample-coring syringes will be obtained from the analyzing laboratory. The following procedure will be adhered to when collecting soil samples for volatile organics analysis:

1. Procure a soil core from the subsurface, either using a core-barrel or split-spoon sampler.

2. Spread a piece of heavy-duty aluminum foil onto a work surface and extrude the soil sample onto the foil.

3. Slice the cylindrical soil sample lengthwise with a clean stainless-steel spatula.

4. Immediately plunge a disposable coring syringe (with the plunger removed) into the mid-section of the core (into undisturbed soil) to capture a 1/2 to 1 inch long sample plug.

5. Immediately insert the plunger into the syringe and extrude the soil sample plug into the vial.

6. Clean around the lip of the vial with a clean laboratory paper tower to remove soil and/or grit, then cap the vial with a teflon-lined septum cap. The teflon side must be toward the sample.

7. Collect a duplicate sample from the other half of the core directly across from the first sample.

8. Label the sample vials using cloth Groundwater Technology labels and waterproof ink. Labels will include the following information:

   a. job name and number
   b. date and time of sample collection
   c. well number and depth of sample
   d. name of sampler
   e. type of analysis requested

9. Fill out chain-of-custody tag attach it to samples, and immediately place the samples on ice.

10. Discard the plastic coring syringe and clean the sampling equipment. Decontamination of equipment in the field requires a detergent wash (alconox soap), a water rinse, and a spectrographic quality acetone rinse, followed by a distilled water rinse.

11. Ship the samples on for chemical analysis and wet weight determination via overnight mail to the laboratory.

F. Water Sampling Procedure for Acidified VOC Samples [EPA analytical method 601, 602, or 624 (holding time - 14 days)]

1. Rinse a clean teflon bailer at least five times with sample water.

2. With an extra 40 ml vial and narrow range pH paper the amount of hydrochloric acid needed to lower the pH to less than 2 will be determined.

3. Squeeze the necessary amount of 50% hydrochloric acid from a vertically held squeeze bottle into a 40 ml vial that has been prepared according to the procedure outlined in Section V C.1 of this document.

4. Pour the sample into the vial. Fill the vial to overflowing, avoiding turbulence and bubbling as much as possible. Water should stand above the top of the vial (i.e.-there should be a convex miniscus above the neck of the vial). If the

sample is for trihalomethane compliance that results from the chlorination of drinking water or the sample is a chlorinated waste water, a few crystals of sodium thiosulfate will be added before filling.

5. Carefully but quickly slip the cap with septum onto the vial with the teflon face of the septum toward the water. Tighten the cap against your hand to assure that there are no bubbles inside. If bubbles are present, open the vial, add a few more drops of sample water, and reseal. Invert the sample vial several times to mix the HCl.

6. Collect a duplicate sample

7. Label the sample vials using cloth Groundwater Technology labels and waterproof ink. Labels will include the following information:

   a. sample indentification number
   b. job identification number
   c. date and time of sample collection
   d. type of analysis requested
   e. name of sampler

8. Fill out chain-of-custody tags. Fill out the chain-of-custody form and reference the preservation techniques in the remarks section.

9. Check to make sure the vial caps are tight, attach the chain-of-custody tags, then place the labeled sample and duplicate on ice immediately.

10. Fill out field data sheet

11. The samplers collected should be stored together with the unopened field blanks that have accompanied the sampler since the outset of the sampling event and were preserved with the same procedure as the samples with the same stock preservative.

The sample set and unopened blanks must be stored together, under refrigeration, in an area known to be free of contamination from solvents and other volatiles.

12. Transport the sample set, on ice, back to the office for shipment to the analyzing laboratory, maintaining chain-of-custody.

VII. Preservation Methods

1. Water sample preservation

Water samples to be analyzed for volatile organics will be preserved by acidifying samples with a sufficient amount of 50% hydrochloric acid to lower sample pH to less than 2, and by cooling to 4 C. Acid for field preservation will be carried in teflon squirt bottles, and fresh acid will be obtained approximately every 4 weeks. Acid will be added to the 40 ml sample vial in a drop-by-drop method. Once the sample pH is less than 2 and the sample has been properly capped and labeled, it will be put on ice immediately and stored away from solvent fumes and light. Samples will be maintained on ice or refrigerated at 4 C until they are analyzed.

Acid preservation will be done in a well-ventilated area. The tip of the acid bottle will not be allowed to come into contact with a sample. If it does, the tip will be flushed 5 times with distilled water and twice with acid before the next sample is acidified.

2. Soil sample preservation

Soil sample preservation will be provided by immediately placing the soil-containing vials on ice to cool the samples to 4 C. Methanol is added to the vial through the septum at the lab within 7 days of sampling. Once the volatiles are dissolved by the methanol, the septum is replaced. The soil and extract are then maintained at 4^0 C until analysis.

VIII. Holding Times

The holding times for volatile organics are 7 days if samples are not acidified and 14 days if they are acidified. Semi-volatile organics samples must be extracted within 7 days and completely analyzed within 40 days of extraction. After samples have been collected, sample sets will be sent to the lab as quickly as possible (via overnight mail) in sealed coolers packed with fresh ice.

IX. MEASURES TO AVOID CROSS-CONTAMINATION OF SAMPLES

A. Well Sampling

Measures taken to avoid cross contamination in well water samples will included the following:

1. Upon arrival at a site, teflon bailer to be used to collect water samples will be rinsed thoroughly with acetone or isopropyl alcohol, then scrubbed with alconox soap and thoroughly rinsed with tap water, followed by a thorough rinse with distilled water.

2. If water quality data are available for a site, the least contaminated well will be sampled first, the second cleanest well will be sampled second, and so on, until the last well is sampled, which will be the most contaminated well. If no water quality data is available, the well suspected to be the cleanest will be sampled first, and wells suspected to be the most contaminated will be sampled last.

3. Between the collection of each sample, the teflon bailer, and the sampler's hands will be scrubbed with alconox soap, followed by a tap water rinsing and then by a thorough rinsing with distilled water. Other items that come in contact with well casing or well water (such as tape measures and hoses) will be rinsed with tap water. Any dirt or adhering particles will be removed with a brush.

4. If any equipment comes in contact with any hydrocarbons such as oily soil, oily clothes, tar, etc. that equipment will be thoroughly rinsed with acetone or isopropyl alcohol, followed by a tap water rinse, alconox soap scrubbing, another tap water rinse, and a thorough rinse with distilled water. Any sampling equipment which has come into contact with liquid hydrocarbons (free product) will be regarded with suspicion. Such equipment will have tubing and cables replaced and all accessible parts will be washed as above. Visible deposits, if

necessary, will be removed with hexane, followed by a rinse and washing as listed above.

5. Upon completion of a round of sampling for a site, sampling equipment will be scrubbed with alconox soap and rinsed thoroughly with tap water, then distilled water. The equipment will then be labeled with the date cleaned, the site or well number the equipment was last used at, and the initials of the sampler.

B. Teflon Tubing

In cases where teflon tubing is used, the tubing will be rinsed with two liters of distilled water before each sample is collected. The tubing will also be rinsed with at least three liters of sample water prior to collecting a sample.

C. Soil Sampling

To avoid cross-contamination during soil sampling, soil that is actually collected as a sample will not have come into contact with the walls of the split spoon or with the sampler's hands. Disposable plastic sysringes (30 ml) will be used to gather and extrude soil samples. These syringes will not be used for more than one sample. The split spoon used to core the soil will be rinsed with acetone or isopropyl alcohol, washed with alconox and water and rinsed with clean water between each sample.

QUALITY CONTROL AND ACCOUNTABILITY

Groundwater Technology, Inc. routinely interacts with government agency enforcement and regulatory officers. Our methods and techniques are subject to scrutiny by the courts, as well as by other professionals in the field of pollution assessment and abatement. Groundwater Technology, Inc. thus employs a rigorous quality control doctrine that is strictly followed by all of its personnel.

All projects periodically undergo intense review by upper management. All laboratory analyses are performed by organizations, including the Groundwater Technology, Inc. Laboratory, that meet or exceed the quality control standards of the U. S. Environmental Protection Agency, the U. S. Public Health Service, and local regulatory agencies. The chain of custody procedures used by Groundwater Technology, Inc. conform with the applicable laws and regulations, as well as the standard of professional practice. Groundwater Technology, Inc. professionals are always ready to support their findings with expert testimony, if necessary.

PEAS(PLAINT/RESPONSE FORM - PLAINWEL DISTRICT

Person Receiving Complaint CHUCK BIKFALVY Incident Number ____________

Date Complaint Received 12/13/88 Time Complaint Received 9:15

Complaint Forwarded to: Name ____________ Division ____________

Information Source: Name KENT MOTTINGER Phone 385-8157

Address KAZOO WWTP

or: Anonymous ____

Complaint: Name ____________ Phone ____________

Address ____________ County ____________

Complaint Content: Source Contained ___ Uncontained ___ Unknown ___ N/A ___

OIL ON KALAMAZOO RIVER AT PATERSON ST

CALLED AGAIN A LITTLE LATER + SAID IT WAS FUEL

OIL COMING FROM CONRAIL YARD

Response Priority: Immediate ___ Next Working Day ___ Next Time in Area ___

When Time Permits ____ No Response Needed ____

Referred to other Division/Department ____________

Response Follow-up: Date 12/13/88 Pictures - Yes/No Samples - Yes/No

ADJUSTED BOOM AT CONRAIL (LOWER END WAS ON SHELF OF

ICE WATER HAD DROPPED, OIL SEEPING OUT FROM BANK UNDER

ICE). BROKE ICE + REPOSITIONED BOOM IN WATER. (MORE) →

Reached one or more of the following resolutions: (circle where applicable)

1. There is no potential for adversely impacting the waters of the state or the environment, and/or threat to the environment is not greater than the risk to public health a clean-up would incur.
2. The contaminant has been removed to background levels.
3. The site/incident has been or will be in litigation with referral.
4. The site/incident has been or will be an Act 307 or Superfund site.
5. The site/incident has been determined to be cleaned up enough such that degradation of the groundwaters has been mitigated or has not and will not occur, and the liable party has appealed to the Department that further action is not necessary with the concurrence of the appointed authority.

Rev. 10/27/86

Responded to by: Chuck Bikfalvy

CC FRANK BALLO
JOHN VOLLMER

CALLED TO[illegible]
YESTERDAY (~~REPORTED~~ OK), WILL ~~BE~~ BACK TOMORROW AM.
ADVISED HIM TO ~~HAVE~~ SOMEONE AT CONRAIL CHECK BOOM
DAILY, ADJUST IF NEEDED. HE SAID HE WOULD ARRANGE

- OIL ON RIVER AT PATERSON WAS VERY LIGHT SHEEN
NOT CONTINUOUS (MOSTLY SPOTS). DEEMED UNRECOVE[RABLE]
ABCE. RETURNED TO OFFICE + INFORMED MR. MOTTINGER.

- AFTER LUNCH KENT M. CALLED AGAIN, SAID OIL THEY (CITY
PERSONNEL) SAW WAS FROM ABANDONED SEWER LINE
DOWNSTREAM OF MILES ST. BRIDGE. SAMPLE OF OIL
WAS COLLECTED FROM SEWER. CITY WANTS SEWE[R]
CLEANED OUT BY CONRAIL, OR THEY WOULD DO IT
AGAIN + BILL THE RR, AS BEFORE. ALSO TALKED TO BR[illegible]

- I THEN CALLED FRANK SOBOTA + DISCUSSED CITY ALLEG[ATION]
+ PLANS. FRANK S. SAID THE CITY MAY AS WELL DO IT, A[S]
A MORE EXPEDIENT OPTION. HE WOULD ALSO CALL TOD[D]
C. + HAVE HIM PUT BOOM AROUND SEWER OUTLET.

- WENT TO SITE AGAIN + INSPECTED SEWER AREA. NO [illegible]
LOOKED AT BOOM AGAIN (HOLDING). WENT TO WWT[illegible]
+ TALKED TO MOTTINGER + MERCHANT. IN MY OPINION,
OIL SEEN IN AREA MUST HAVE BEEN FROM UPSTREAM
SOURCE (AT BOOM), SINCE THERE WAS NO STAINING O[R]
TRACE OF RESIDUAL OIL AT SEWER. CITY STILL
INTENDS TO CLEAN SEWER + BILL CONRAIL, THEN
FILL SEWER WITH CEMENT (AFTER DISCUSSING WITH
FRANK BALLO)

CONRAIL

RECEIVED
AUG 29 1988
SWQD-Plainwell

August 16, 1988

Mr. John Vollmer
Michigan Department Of
Natural Resources
621 Tenth Street
P. O. Box 355
Plainwell, Michigan 49080

RE: Conrail - Botsford Yard
Kalamazoo, Michigan

Dear Mr. Vollmer:

This is in reference to your letter of July 28, 1988 and the phone conversation on August 12, 1988 between yourself and Frank Sobota of this office.

The following course of action has been implemented in order to remediate the oil contamination problem at Botsford Yard:

1. Conrail personnel continue to inspect and maintain the oil absorbent booms in the Kalamazoo River. A facility inspection report detailing the boom maintenance and the oil recovery operations has been instituted. Your office will be provided with a copy of the inspection report.

2. The existing oil recovery system at the yard has been updated with the installation of new pumps. A total of 45,700 gallons of product has been recovered to date.

3. An abandoned underground storage tank containing #6 fuel oil has been discovered in the area of the roundhouse. This tank is tentatively scheduled for removal during the week of August 15, 1988. Your office will be kept advised of this removal project.

RE: Conrail - Botsford Yard
Kalamazoo, MI

4. We are preparing the required documents to engage the services of a contractor to develop a hydrogeologic study to define the extent of the fuel oil contamination and its impact on the groundwater. Work plans will be submitted to your office when received from the contractor.

If you have any additional questions, please contact F. W. Sobota of this office.

Sincerely,

T.P. Pendergast

T. P. Pendergast
Director,
Environmental Affairs
606 Six Penn Center
Philadelphia, Pennsylvania 19103

FWS/cb

STATE OF MICHIGAN

NATURAL RESOURCES COMMISSION
THOMAS J. ANDERSON
MARLENE J. FLUHARTY
KERRY KAMMER
O. STEWART MYERS
DAVID D. OLSON
RAYMOND POUPORE

JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

GORDON E. GUYER, Director

District 12 Headquarters
P.O. Box 355, Plainwell, Michigan 49080

March 29, 1988

T. P. Pendegast, Director
Conrail Environmental Affairs
6 Penn Center
Room 606
Philadelphia, Pennsylvania 19103

Re: Conrail Mill Street Facility, Kalamazoo

Dear Mr. Pendegast:

This confirms previous conversations I've had with Frank Sabota of your staff on the above-referenced facilty.

Recent events have indicated that oil recovery systems previously installed at the Mill Street site are inadequate to remediate the historical diesel contamination there. Conrail has committed to maintaining the oil booms on the Kalamazoo River and removing oil from the abandoned sanitary sewer line and the existing oil collection systems as an interim response to minimize surface water impacts. This, however, is inadequate to remediate the site's substantial soil and groundwater contamination.

In order to comprehensively address environmental problems at the site, Conrail should take the following steps:

1. Develop a free product recovery plan and implementation schedule designed to eliminate oil migration from your firm's property.

2. Develop a hydrogeologic study plan and implementation schedule designed to define the extent of hydrocarbon contamination and determine all sources of petroleum impacting the groundwater. The results of this study will be used to develop a corrective action plan to remediate groundwater contamination.

3. Determine the status of any underground storage tanks at the facility. Tanks and lines currently in service should be tested for tightness. Any tanks of questionable integrity and all abandoned tanks should be taken out of service and removed per specifications of the Kalamazoo Fire Marshal's office.

Please reply with your firm's intentions in this matter by April 15, 1988. Please submit the free product recovery plan and hydrogeologic study plan to this office for review by April 29, 1988.

If you have any questions or need additional information, feel free to contact me. I'd be happy to meet with you, members of your staff, or your consultant to discuss this further.

Sincerely,

Frank Ballo

Frank Ballo
Environmental Response Division
Plainwell District
616-685-9886

FB/cw

cc: William Thacker, James River Corp.
Bruce Minsley, Kalamazoo Public Utilities Dept.
Dan Starkey, Kalamazoo Water Reclamation Plant
Marty Myers, Kalamazoo Public Safety Dept.
Pat Krause, Kalamazoo County Human Services Dept.
Fred Morley, SWQD
Linda Koivuniemi, SWQD
Tom Work, ERD

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

January 29, 1980

I agree with first recommendation but not with sec. if info has already been sent to Lan in past on correct measures
MS

RECEIVED

FEB 27 1980

DISTRICT 3
WATER QUALITY DIV.

TO: Problem Evaluation Committee

FROM: Dennis Swanson

SUBJECT: Penn Central (Conrail), Kalamazoo

During a May, 1973 investigation at Auto-Elon personnel of the Bureau of Water Management noted oil seepage from a 200 foot section of the river bank. Subsequent investigation showed this to be due to past and present practices in the fueling area. Sampling in the Kalamazoo River showed a level of 6400 ppm of number 2 fuel oil and a sample from a sanitary sewer below the facility showed 890 mg/l.

In the period of approximately one year after the initial visit, the company was required to improve the refueling area by better tanks and containment and to begin pumping the oil from the ground water well. Recovery was done by A-1 Disposal; the latest entry in the files (January, 1978) shows 122,250 gallons of oil recovered over the ensuing years.

I called Roger Prysbyz on January 28, for an update and he indicated he has not followed up on this since 1978 because of other priorities. He indicated he would make prompt contact again. This problem is listed in the December, 1979 report of identified groundwater contamination concerns.

Recommendations

1. Prompt visitation and review of status of contamination and cleanup.

2. District 3 staff prepare a sketch of corrective measures established for the Industrial file on this company.

These recommendations were agreed upon by the Problem Evaluation Committee.

John B. Robinson

John C. Robinson, Chairman

cc: M. Beck

WATER QUALITY DIVISION
State of Michigan Office Building
350 Ottawa Avenue, N. W.
Grand Rapids, Michigan 49503

January 24, 1978

Mr. Norman Knapp
Bridge and Building Supervisor
Consolidated Rail Corporation
501 East Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Knapp:

On January 11, 1978, as previously scheduled, a review of the recovery effort at the Botsford Yard in Kalamazoo was made. Mr. Don Forster of A-1 Disposal and I conducted an inspection of the yard and river bank, and measured the oil layer thickness at each of the four recovery wells.

Listed below is the thickness of the oil layer in inches for each of the four wells. The wells had not been pumped for several days prior to our meeting.

Well #1	2-1/2"
Well #2	2"
Well #3	12"
Well #4	6"

Updating the pumping records shows that the total oil recovered thus far through December of 1977 is approximately 122,250 gallons of oil. The records for October through December 1977 show a total of 3,050 gallons of oil removed for this quarter. A-1 Disposal was instructed to continue the weekly pumping of each of the recovery wells.

The next meeting has been tentatively scheduled for April 12, 1978.

Very truly yours,

WATER QUALITY DIVISION

Roger Przybysz

Roger Przybysz,
Water Quality Specialist

RP/mc
cc: Karl Zollner
PEAS File (646-74)
Don Forster
Frank Manganaro

QUESTIONABLE INDUSTRY LIST

1. Name and location of source Penn Central Railroad (Conrail)
Botsford Yards Mills St. Kalamazoo

2. Description of the processes and products This facility is a railroad yard used for refueling and some servicing of locomotive engines

3. Quantity and quality of wastes discharged to the surface waters; to the groundwater Over a period of time oil from overfilling, storage and poor housekeeping have resulted in large quantities of oil present in the groundwater near the Kalamazoo River

4. Discharges made under a Permit? No Order No

5. In compliance? If not, describe nature of noncompliance and parameters and conditions out of compliance
N/A

6. Have discharges been evaluated by DNR studies? Staff evaluation Date Quarterly since [illegible]

7. Quantity and quality of wastes or toxic/hazardous materials in storage or on site
Diesel Fuel

8. Has an approved P.I.P. Plan been implemented? Yes

9. Recommendations for obtaining additional information None
Quarterly reports [illegible] sent in on the incident for the last [illegible] years.

10. Other comments Recovery [illegible] [illegible] Over [illegible] have [illegible] recovered [illegible]. [illegible] Conrail [illegible] to [illegible] agreement to continue [illegible] recovery [illegible].

WATER QUALITY DIVISION
State of Michigan Office Building
350 Ottawa Avenue, N. W.
Grand Rapids, Michigan 49503

November 3, 1977

Mr. Norman Knapp
Bridge and Building Supervisor
Consolidated Rail Corporation
501 East Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Knapp:

On October 11, 1977, as previously scheduled, a review of the oil recovery effort at the Botsford Yard in Kalamazoo was made. Dr. Don Forster of A-1 Disposal, Mr. Peterson representing Con-Rail, Mr. Sid Beckwith, Mr. Dave Rymph and myself representing the Department of Natural Resources, Water Quality Division, made an inspection of the yard and river bank. In addition, we measured the oil layer thickness at each recovery well. Listed below is the thickness of the oil layer in inches for each of the four wells. The wells had not been pumped the week preceeding our meeting:

Well #1	3"
Well #2	3.5"
Well #3	3.5"
Well #4	5"

Pumping records to date show total oil recovered thus far through September of 1977 is approximately 119,200 gallons. Records for July through September of 1977 show a total of 11, 150 gallons of oil removed for this quarter.

A-1 Disposal was instructed to continue weekly pumping since a rich quantity of oil is continuing to be recovered.

The next meeting has been tentatively scheduled for January 11, 1978.

Very truly yours,

WATER QUALITY DIVISION

R.P.

Roger Przybysz,
Water Quality Specialist

RP/mc
cc: Karl Zollner

WATER QUALITY DIVISION
State of Michigan Office Building
350 Ottawa Avenue, N. W.
Grand Rapids, Michigan 49503

Jul

Mr. Norman Knapp,
Bridge and Building Supervisor
Consolidated Rail Corporation
501 East Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Knapp:

On July 12, 1977 as previously scheduled, a review of the oil recove at the Botsford Yard in Kalamazoo was made. Mr. Don Forster of A-1 Dispo myself made an inspection of the yard and river bank in addition to meas oil layer thickness at each recovery well.

Listed below is the thickness of the oil layer in inches for each of four wells. The wells had not been pumped the week of our meeting.

Well #1	5-3/4"
Well #2	4"
Well #3	6"
Well #4	15"

Pumping records to date show total oil recovered thus far through J is approximately 108,050 gallons. Records for April through June of 1977 total of 7,050 gallons of oil removed for this quarter.

Since a rich quantity of oil is continuing to be recovered, A-1 Dis instructed to continue weekly pumping.

Yard personnel also indicated there may be some planned changes in area and roundhouse facility. If such plans are being developed, we woul opportunity to review these plans to make sure adequate precautions for c tainment are being provided. Your comments on this matter are requested.

The next meeting has been tentatively scheduled for October 11, 1977

Very truly yours,

WATER QUALITY DIVISION

Roger Przybysz,
Water Quality Specialis

rp/cc
cc: PEAS File (646-74), Karl Zollner
Don Forster, Frank Manganaro

WATER QUALITY DIVISION
State of Michigan Office Building
350 Ottawa Avenue, N. W.
Grand Rapids, Michigan 49503

April 26, 1977

Mr. Norman Knapp
Bridge and Building Supervisor
Consolidated Rail Corporation
501 East Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Knapp:

On April 12, 1977 as previously scheduled, a review of the oil recovery effort at the Botsford Yard in Kalamazoo was made. Present at the meeting was Mr. Don Forster of A-1 Disposal, Mr. Peterson representing Conrail, Mr. Chester Harvey, and myself. The pumping records to date were reviewed along with an inspection of the yard, and a measurement of the oil thickness at each recovery well.

Listed below is the depth of the oil layer in inches for each of the four wells. The wells had not been pumped the week prior to our meeting. Please refer to the attached map for the proper numbering.

Well #1	1"
Well #2	2"
Well #3	11"
Well #4	9"

Total oil recovered thus far through March 1977 is approximately 101,000 gallons. Records for January through March 1977 show a total of 3,005 gallons of oil removed for this quarter.

Our inspection of the refueling pad found the buried tank which receives drainage from the curbed area full of oil. This should have been pumped out. In addition, the gutters have not been properly maintained. This reiterates our continuing concern that there is no one at the Botsford Yard responsible for proper maintenance of the yard to prevent oil spillages. In the five years since this recovery operation has taken place, I find little improvement in minimizing spills at the yard.

It is also our understanding that the existing storage tank for diesel fuel has failed, and presently, the fuel is being trucked in. If there are plans to install a new bulk storage tank for diesel fuel, the plan for locating and diking of the tank must be presented to our office for approval.

Since we are continuing to recover a rich quantity of oil, A-1 Disposal was instructed by me to continue weekly pumping, and more frequently if a significant accumulation of oil is present.

The next meeting has been tentatively scheduled for July 11, 1977.

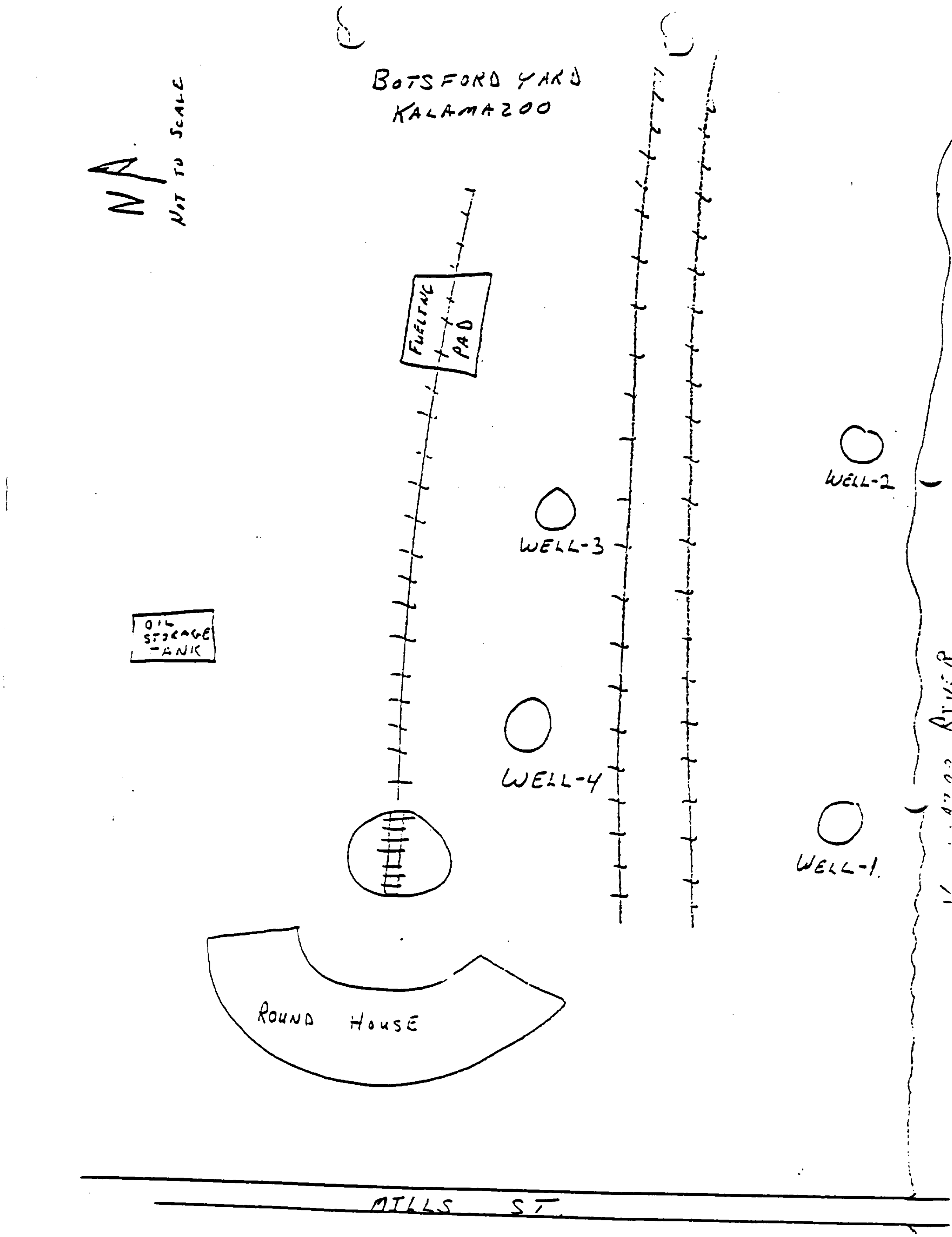
If there are any questions regarding this matter, please call.

Very truly yours,

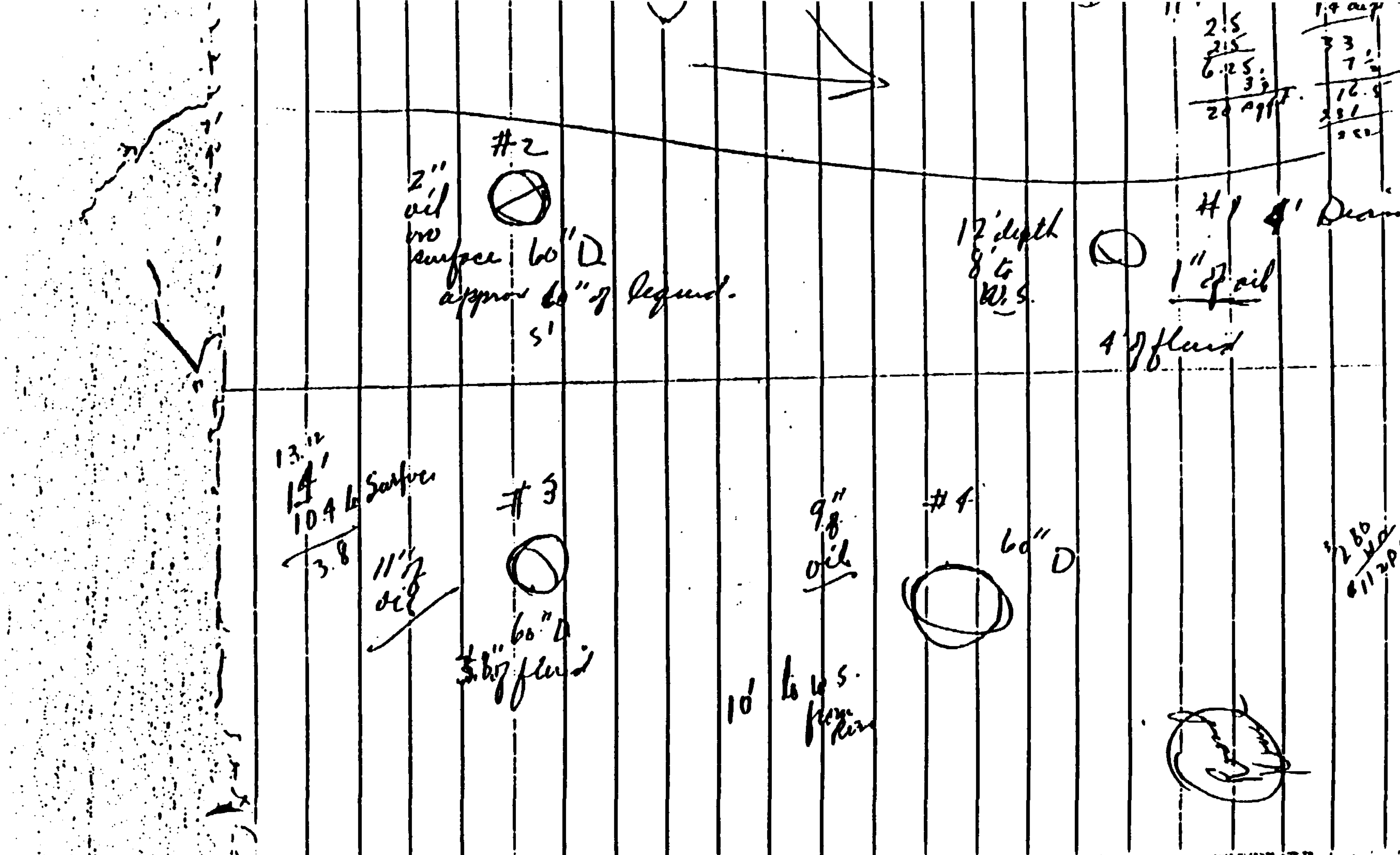
WATER QUALITY DIVISION

Roger Przybysz,
Water Quality Specialist

RP/mc
cc: Karl Zollner
P.E.A.S. File (646-74)
Don Forster, A-1 Disposal
Frank Manganaro, Penn Central



BOTSFORD YARD
KALAMAZOO
N
NOT TO SCALE
FUELING PAD
OIL STORAGE TANK
WELL-3
WELL-2
WELL-4
WELL-1
ROUND HOUSE
MILLS ST.



Bridge Inspector

WATER QUALITY DIVISION
State of Michigan Office Building
350 Ottawa Avenue, N. W.
Grand Rapids, Michigan 49503

January 13, 1977

Mr. Norman Knapp
Bridge and Building Supervisor
Consolidated Rail Corporation
501 East Michigan Avenue
Jackson, Michigan 49001

Dear Mr. Knapp:

On January 11, 1977, as previously scheduled, a review of the Botsford Yard in Kalamazoo oil recovery effort was made. Mr. Don Forster of A-1 Disposal, and I reviewed the pumping records to date, and also measured the depth of oil in each of the four recovery wells.

Listed below is the depth of the oil layer in inches recorded for each of the four wells. The wells had not been pumped for a period of seven (7) days prior to our measurement. The next scheduled pumping is on the 12th or 13th of January. Please refer to the attached map for the proper numbering.

Well No. 1	14"
Well No. 2	4"
Well No. 3	2"
Well No. 4	4"

It is easy to see that the heaviest accumulation of oil is in Well No. 1. Mr. Forster was instructed to pump this well completely down the next couple of times. Hopefully, this will also eliminate the small amount of seepage which has been occurring near this well. If this seepage continues, it may be necessary to install an additional recovery well to the west, behind the billboards.

A-1 Disposal was instructed to pump weekly, and if necessary this spring, to pump twice weekly if there is a significant oil accumulation in this well or any of the other wells.

More

A-1 Disposal will also continue to report to this office the volume of oil removed.

The next meeting date has tentatively been scheduled for April 12, 1977. Hope to see you then.

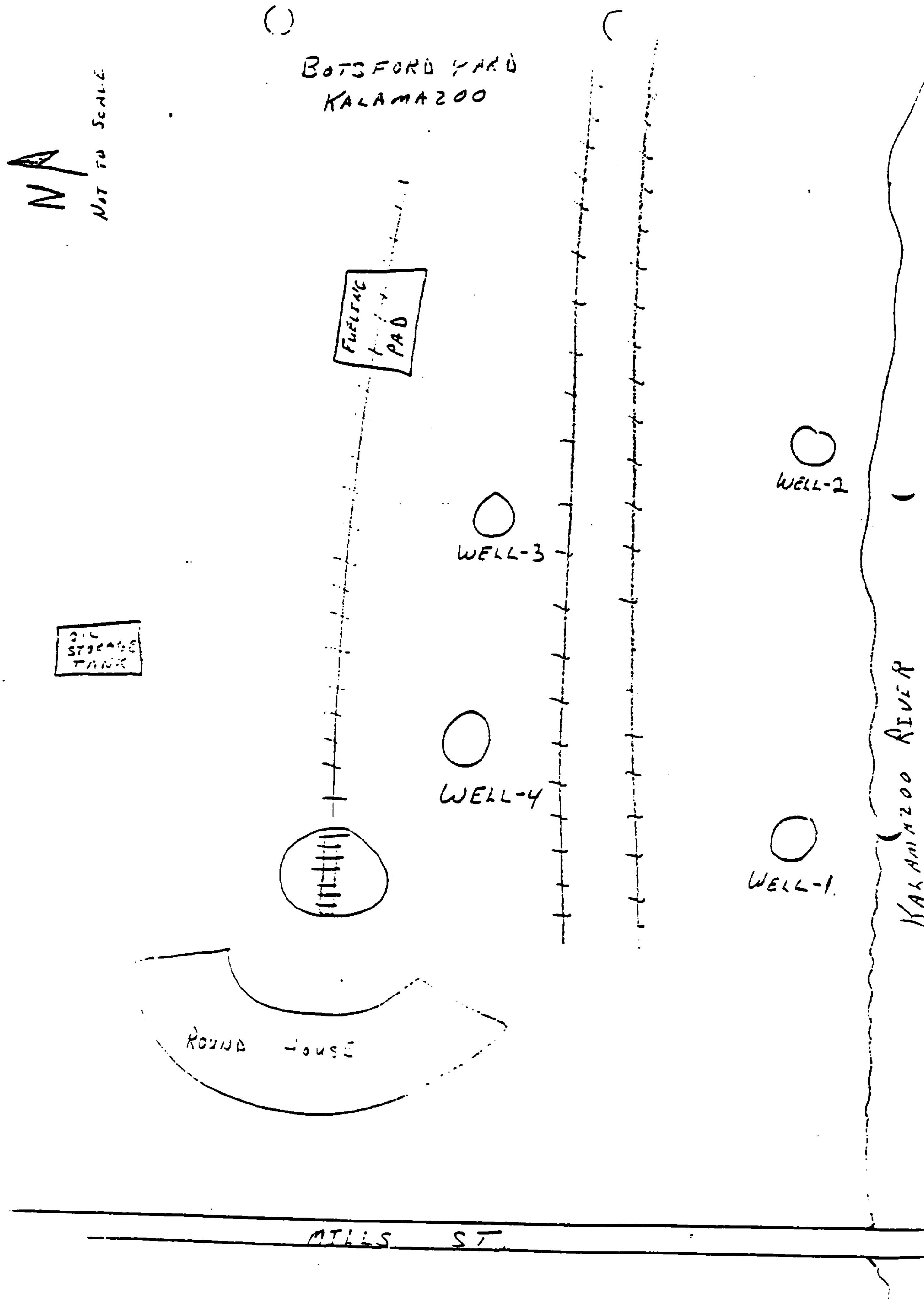
If you have any questions regarding this matter, please call.

Very truly yours,

WATER QUALITY DIVISION

Roger Przybysz,
Water Quality Specialist

RP/mc
cc: Don Forster
Karl Zollner
P.E.A.S. File



BOTSFORD YARD
KALAMAZOO
N
NOT TO SCALE
FUELING PAD
OIL STORAGE TANK
WELL-1
WELL-2
WELL-3
WELL-4
ROUND HOUSE
KALAMAZOO RIVER
MILLS ST.

WATER QUALITY DIVISION
State of Michigan Office Building
350 Ottawa Avenue, N.W.
Grand Rapids, Michigan 49503

January 3, 1977

Mr. Dick Shumaker
Commercial Pumping and Incineration
P. O. Box 301
Plainwell, Michigan 49080

Dear Mr. Shumaker:

This is to remind you of the next scheduled meeting January 11, 1977 at 10:00 A.M. at the Botsford Yard in Kalamazoo to review the oil recovery efforts.

Since our last meeting, we have moved to our new office building at 350 Ottawa Avenue, Grand Rapids. Our new telephone number is 456-6231. If it is not possible to make this meeting, please give me a call so that an alternate date may be scheduled.

Total oil recovered as of December 1976 is approximately 98,000 gallons. Total oil recovered in 1976 is approximately 18,800 gallons, averaging 1,700 gallons per month.

These figures indicate that recovery of the oil should continue at a steady pace.

Very truly yours,

WATER QUALITY DIVISION

Roger Przybysz,
Water Quality Specialist

RP/mc
cc: Karl Zollner
P.E.A.S. File No. 646-74

WATER QUALITY DIVISION
State of Michigan Office Building
350 Ottawa Avenue, N.W.
Grand Rapids, Michigan 49503

January 3, 1977

Mr. Norman Knapp
Bridge and Building Supervisor
Consolidated Rail Corporation
501 East Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Knapp:

This is to remind you of the next scheduled meeting January 11, 1977 at 10:00 A.M. at the Botsford Yard in Kalamazoo to review the oil recovery efforts. Since our last meeting, we have moved to our new office building at 350 Ottawa Avenue, Grand Rapids. Our new telephone number is 456-6231. If it is not possible to make this meeting please give me a call so that an alternate date may be scheduled.

Total oil recovered as of December 1976 is approximately 98,000 gallons. Total oil recovered in 1976 is approximately 18,800 gallons, averaging 1,700 gallons per month.

These figures indicate that recovery of the oil should continue at a steady pace.

Very truly yours,

WATER QUALITY DIVISION

Roger Przybysz,
Water Quality Specialist

RP/mc
cc: Karl Zollner
P.E.A.S. File No. 646-74

4056 Plainfield Avenue, N. E.
Grand Rapids, Michigan 49505

December 30, 1975

Mr. Frank L. Manganaro
Manager, Environmental Control
Penn Central Transportation Company
Six Penn Center Plaza
Philadelphia, Pennsylvania 19104

Re: Oil Recovery at Mill Street
Botsford Yard, Kalamazoo, Michigan

Dear Mr. Manganaro:

Since our meeting in Lansing on January 10, 1974, regarding oil recovery at the Botsford Yard and the completion and placing in service of the oil recovery system at the Botsford Yard on January 16, 1975, this office has been unsuccessful in working with local Penn Central personnel in achieving a consistent program of oil recovery at the Botsford facility. Enclosed are letters dated April 17, 1975, and September 23, 1975, which reiterate attempts to achieve a workable arrangement. As of this date, no response has been received. A recent inspection of the recovery wells indicated a substantial quantity of oil still is unrecovered.

Therefore, please be advised that if the program outlined in our letter of April 17, 1975, is not implemented within thirty (30) days, this matter will be referred to the Michigan Attorney General's office for proper enforcement action.

Very truly yours,

WATER RESOURCES COMMISSION

Roger Przybysz
Water Quality Investigator

RP:as

Enclosures

cc: Karl Zollner

MONTHLY OPERATING REPORT FOR April, 1975

File → PENN CENTRAL TRANSPORTATION COMPANY

BOTSFORD YARD, MILL STREET, KALAMAZOO, MI

DATE	VOLUME OF OIL REMOVED FROM RECOVERY WELLS (GALS.)
4/14/75	2600 gal

[signature]

Signature of Bridge and Building Supervisor

One copy of this form is to be submitted at the end of each month to:

WATER RESOURCES COMMISSION
4056 Plainfield Avenue, N. E.
Grand Rapids, Michigan 49505 (District #3 Office)

WATER RESOURCES COMMISSION
4056 Plainfield Avenue, N. E.
Grand Rapids, Michigan 49505

March 7, 1975

Mr. J. T. Sullivan, Chief Engineer
Penn Central Transportation Company
Six Penn Center Plaza, Room 600
Philadelphia, Pennsylvania 19104

Re: Oil Recovery at Mill Street
Botsford Yard, Kalamazoo, Michigan

Dear Mr. Sullivan:

This is to acknowledge receipt of your letter dated February 14, 1975 addressed to Mr. Zollner regarding the completion and placing in service on January 16, 1975, facilities constructed according to Plan No. 46632 at the subject location.

Although completion of these facilities is a positive step in preventing future spillage, recovery of the diesel fuel still present in the ground should continue. Figures reported by the oil recovery contractor indicate that a total of 54,000 gallons of diesel fuel have been pumped from the recovery points as of December 31, 1974. The last monthly report of oil removal submitted by Penn Central personnel was for July 1974. Subsequent reports have not been received.

Since oil recovery efforts began, several visits have been made to the Botsford Yard to check on the river bank condition and oil recovery progress. One point of concern which may have been overlooked which warrants your attention is the existing diesel fuel storage tank. In all observations of the concrete pit which contains the fuel supply tank, two to six inches of diesel fuel have been observed in the bottom of the pit. Based on these observations, I have serious doubts regarding the integrity of the pit and the supply tank itself. Therefore, a hydrostatic test or equivalent testing should be completed to determine the origin of the leaks to the concrete tank.

More

In order to be expeditious with our time, and thus minimize the need for time-consuming written dialogue, I would appreciate the ability to contact some responsible individual locally regarding the matter as mentioned above.

Your comments are requested at your earliest convenience.

Very truly yours,

WATER RESOURCES COMMISSION

Roger Przybysz,
Water Quality Investigator

RP/mc
cc: Karl Zollner
Frank L. Manganaro
Manager Environmental Control
Penn Central Transport Co.
30th Street Station, Room 360
Philadelphia, Pa. 19104

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

TO: Karl Zollner

FROM: Roger Przybysz

DATE: January 20, 1975

SUBJECT: Penn Central Railroad
Botsford Yard, Mill Street
Kalamazoo

Loss No. 646-74

In November of 1974, construction started on the enclosed fueling station at the Botsford Yard. Recovery of oil from the groundwater is being done by A-1 Disposal on a weekly basis. To date the total gallons recovered is 54,000 according to figures provided by A-1 Disposal.

The yard is visited by me at least once every other month and each time I check the diesel fuel storage tank pit and find at least 2 to 3 inches of diesel fuel on the bottom of the pit. On my last visit, some attempts were made to patch the cracks in the storage tank pit walls. Seepage from the Kalamazoo River bank was minimal, isolated to a few rainbow pockets here and there.

It is my understanding that Ed Sykora who was in charge of filling out the monthly reports for oil removal has been promoted to train master at the Lansing Yards.

RP/mc

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

REPORT OF OIL, SALT OR POLLUTING MATERIAL LOSSES

Pursuant to the provisions of Act 245 of the Public Acts of Michigan 1929 as amended, regulations have been issued which require that all owners, managers or operators of vessels, oil storage or on land facilities shall notify the Water Resources Commission or his authorized representative of oil, salt and polluting material losses. This notification shall be made promptly by telephone or telegraph, giving briefly the particulars, and by mail, giving a detailed account of events and conditions.

Date: 10-11-83
Company Name: Conrail

Location of Loss (Be Specific): 75 Mill St Kalamazoo

Material Lost: Diesel #2 Fuel Oil
Amount: 300-400 Gals.
Name of surface water involved: Kalamazoo River

Date Loss was Discovered: ctober 11, 1983
Time of Discovery: 1:00 A.M.

Name of Department of Natural Resources Representative Contacted: Operator #26

Telephoned or Telegraphed by Whom: F. M. Arcaro
Time: 6:15 A.M.

Cause of Loss (Include Type of Equipment and Other Details): Derailment of Locomotive CR 8173

Extent of Loss (Include Complete Description of Damage): CR 8173(Engine) derailed, causing fuel tank to rupture, discharging approximately 400 gallons of fuel.

Additional Comments (Include Method of Control, Plans for Prevention of Recurrence, etc.)

DIVISION SUPERINTENDENT
JACKSON, MI.

OCT 12 1983

(Signature) J. W. Meadows, Div. Supt.

Return this form to: ~~Oil and Hazardous Materials Control Section~~
~~Water Quality Division~~

P.O. Box 355
Plainwell, MI
49080

FILE No. ~~204 Surrey~~ St.
Mt. Pleasant, Mich. 48858
Tel. 517/773-9965

Box 30028
Lansing, Mich. 48909
24 hr. Emergency Notification Number
517/373-7660

R4615

DEPARTMENT OF PUBLIC UTILIT
Water Sup
415 Stockbr
Kalamazoo, Michigan 49001-28
(616) 385-81

RECEIVED
APR 28 1988
ERD-PLAINWELL

April 26, 1988

Mr. Mark Owens
Conrail
501 E. Michigan Ave.
Jackson, MI 49201

Re: Conrail Oil Spill in the Kalamazoo River

Dear Mr. Owens:

Enclosed is an invoice from the City of Kalamazoo for the personnel and equipment used to respond to the oil spill on Mills Street. I'm also forwarding the original invoice from A&B Industrial Services in the amount of $5971, for their work to remove the oil from the river.

Your prompt attention to this matter will be greatly appreciated. If you have any questions, please give me a call at (616) 385-8149.

Sincerely yours,

Jerri Barnett-Moore
Jerri Barnett-Moore
Customer Service & Finance Mgr.

enclosures

cc: Bruce Merchant, Dept. of Public Utilities
Frank Ballo, Michigan Department of Natural Resources
A&B Industrial Services, Accounting Section

Date Complaint Received 3/24/88 Time Complaint Received 8:10

Complaint Forwarded to: Name John Vollmer Division

Information Source: Name Bill Thacker - Phone 383-5000

Address

or: Anonymous

Complaint: Name Phone

Address County

Complaint Content: Source Contained ___ Uncontained ___ Unknown ___ N/A ___

OIL ON KALAMAZOO - NOTICED AT PATTERSON AVE AND COMPANY WAS AFRAID IT WOULD GET INTO THEIR INTAKE - INVESTIGATED AND DISCOVERED IT [illegible] @ MILL STREET.

Response Priority: Immediate X Next Working Day ___ Next Time in Area ___

When Time Permits ___ No Response Needed ___

Referred to other Division/Department

Response Follow-up: Date 3/24/88 Pictures - Yes/No Samples - Yes/No

8:15 Called City of Kalamazoo - Kent Montague advised him of the problem and requested the city to investigate.

8:20 Contacted John Vollmer to followup also.

10:00 Kent Montague called back to advise they had located the sewer and was [illegible] to determine the source. Suggested they get in touch w/ A+B

10:15 John V. called back to advise the source - storm sewer & Council [illegible] is pursuing [illegible] w/ Council

1:30 John V called to bring me uptodate with what he had learned. A+B on site - sewer will be pumped out - boom at river. Council to install a boom along their frontage. Source to storm sewer appears to be from an abandoned sanitary sewer - [illegible] area appears dry.

1400-1405 - Channel 3 + WKMI Called + Jeff [illegible] [illegible]

JCC

APPENDIX B

SELECTED REFERENCES RELATED TO THE PRODUCTION PAINTING FACILITY

AUTO-ION CHEMICALS INC.

INDUSTRIAL & POWER CHEMICALS

[illegible]

KALAMAZOO, MICH.

TELEPHONE
344-0151
344-0152

To Whom It May Concern:

July 30, 1971 a discharge consisting of yellow colored substance was being discharged from the Acolor Inc, 1032 O'Neil through a 2 inch hose. This effluent run for 3½ hours onto the property of Auto-Ion Chemicals Inc. and through the sludge pit after which it proceeded into the river.

Signed:

Michael Penny

John Shank

Victor Morrow

Fred Keyser

James J. Rooney

DEP. EX. NO. 58
FOR ID. AS OF 9/21/84

008921

FAX.106/GAS/08-91

EASTMAN & SMITH

ATTORNEYS AT LAW
800 UNITED SAVINGS BUILDING
TOLEDO, OHIO 43604-1141

TELEPHONE (419) 241-6000
TELECOPIER (419) 241-5568

FAX TRANSMISSION SHEET

DATE: May 26, 1992

FILE NO: K325/26697

NUMBER OF PAGES: 4 (Including This Sheet)

TO: Mika McLeod

FROM: Amy Arkebauer

MESSAGE: The following, per our conversation of today, are pages 91-93 of the deposition of James Rooney. Please call if you should need additional information.

TELECOPY NUMBER: (313) 747-6530

IN CASE OF PROBLEM, CALL EXTENSION 210 AT (419) 241-6000.

☐ If checked, Please confirm receipt of document.

Date & time sent ____________________ Sender's Initials _______

Q Did you clean your trucks the same way?

A The trucks would be cleaned under hose. Yes. The hose area would come out, and then it would go back into a holding area we had -- pumping it back up into our tanks. We had a funnel shape deal out there. I don't know if you notice that the -- are you familiar with the plant up there?

Q No. I have not been out to the facility.

A Well, there is a big plastic funnel area that we would pump into the -- it would go into a sump, and then it would be pumped up into that area where we would hold them when we cleaned the trucks. It would go right up into that area there.

Let's see. ACOLOR -- there is a place next door called ACOLOR. Are you familiar with them?

Q I am not. I think Ms. Castaric is a little bit more familiar with the area.

A You can stick a hose through there at night or something. I picture the hose sticking through the building, and it pumps the stuff out on our property. And we couldn't figure out what was going on. We finally caught them, and I have got pictures of that.

Q Now, who was doing this?

A ACOLOR Company next door.

Q Was that a painting company?

A Painting. Right. We called a police officer up at the time. He saw it, too.

BY MR. KOWALSKI:

Q Did he make out a police report?

A I think I did. I know I was really on him to try and get this thing straight -- to get it, you know, documented there.

Q Do you know when that occurrad?

A I have got the date and everything right on the picture.

BY MS. ADAMS:

Q And the picture is in this trailer?

A I hope they are there.

BY MR. KOWALSKI:

Q Did you do any kind of analysis on what was being pumped onto your property?

A Yes.

Q What were the results of that?

A Show they were chrome. They were using a chrome product they were running out there. And, let's see. They had some solvents, trichlorethylene and ethylene dichloride, and I think there was some lead pigment.

Q Is that analysis documented on some kind of paper that you might still have?

A I think I do. I am not sure now. I would have to search all -- oh, my God! This has been some years. I think we do have that because I remember that I did have it.

BY MS. ADAMS:

Q At what point did Mr. Clement and Mr. Bullard come on board as owners of the Auto-Ion?

A I was with Mr. Bullard in a company called Tri-Chem, Incorporated, and he had -- we had in with us -- we had -- let's see. A fellow named Jack Hayward was in on it, and we had a fellow named William Peck. And we had John Upjohn in on it. So we had nothing but money.

Q Tri-Chem was --

A A pharmaceutical company.

Q Was not something that was related to the Auto-Ion --

A Yes. Then they merged. Then Bullard was in on it, and he took -- he came from Tri-Chem into our operation.

Q Okay. What year was that?

A Let's see. That got into their -- that was at the early part. That was in 1960.

Q Okay. What about -- that was Mr. Bullard. What about Mr. Clement?

A He came in -- Mr. -- let's see. It was -- with Mr. Bullard, it was 1961, and then this Tri-Chem in which I was an engineer working for them was formed in -- I think that was '57.

GROUNDWATER AND SOIL ASSESSMENT

for

PRODUCTION PAINTING COMPANY
1002 O'Neil
Kalamazoo, Michigan 49001

Prepared for:

JERRY CARLSON REALTY
5413 South Westnedge
Kalamazoo, Michigan 49008

Prepared by:

MAECORP Incorporated
8180 Valley Point Drive
Caledonia, Michigan 49316

August 15, 1989

Job #MI-A071

TABLE OF CONTENTS

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2.0	Soil Boring and Observation Well Installation	2-4
3.0	Analytical Results	5-6
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Appendices
- A. Site Maps
- B. Chain of Custodies
- C. Analytical Results
- D. Well Construction Logs
- E. Well/Boring Logs

1.0 INTRODUCTION

The Production Painting Company (PPC) facility in Kalamazoo, Michigan located along the Kalamazoo River is no longer in operation. Tentative realty transactions have led to the necessity of a site assessment. Site work, including soil borings and a visual inspection of the building interior, was performed by Wilkens and Wheaton Environmental Services, Inc. in January, 1989.

The former Superfund site, Auto Ion, borders the PPC facility to the East. Due south within approximately 15 feet, is the Kalamazoo River. These two adjacent boundaries (east and south) are critical in the assessment of the groundwater quality and flow patterns.

MAECORP installed three soil borings/monitoring wells outside the northeast, west and southern sides of the property on July 20, 1989. Soil samples were collected on July 20, 1989, while water samples were collected on July 21, 1989. Both were analyzed for metals and organic compounds.

The three soil borings/monitoring wells were installed in an attempt to assess if contamination from the former Auto Ion site is having a detrimental impact on the groundwater quality of the PPC facility, evaluate the groundwater quality at the rear of the building in the known toluene spill area, and to determine the groundwater flow pattern across the site.

2.0 SOIL BORING AND OBSERVATION WELL INSTALLATION

On July 20, 1989 a drill rig was utilized to install three observation wells on the PPC property. The first well was intended to be placed along the eastern side of the property near the Auto Ion property. However, due to a lack of space and an abundance of trees and brush a well could not be placed along the eastern edge of the the property. Instead, a well (OW-1) was placed as close to the eastern edge of the property as feasibly possible at the northeast corner of the property. On the western edge of the property was placed observation well #2 (OW-2). The third and final observation well (OW-3) was placed between the PPC building and the Kalamazoo river in the area of a known toluene spill.

While drilling each of the three wells, 2' split spoon samples were taken continuously down to one foot into the water table. Certain split spooned soil samples were field analyzed with a photo ionization detector (PID) for the presence of volatile organics. The following are the results:

WELL #	DEPTH	CONCENTRATION (PPM)
OW-1	4'- 6'	1.0
OW-1	6'- 8'	1.3
OW-1	8'-10'	3.0
OW-2*	2'- 4'	0.4
OW-3	0'- 2'	30.0
OW-3	2'- 4	1.0
OW-3	7'- 9'	0.5
PID Background		0.4

*More samples were not obtained due to the presence of concrete and bricks.

The drill rig continued to auger down to a depth in which the screen would straddle the groundwater table. Each well was constructed of 2-inch outside diameter, flush jointed, schedule 40 threaded PVC casing. Five feet of 2-inch outside diameter, 0.010 inch machine slotted PVC screen was utilized to ensure that the potentiometric surface was straddled by the screen. The annular space surrounding the screened interval was backfilled with a filter pack consisting of fine graded silica sand. The filter pack extended from the bottom of the boring to 1 to 2 feet above the screened in area. A pelletized bentonite seal was placed above the filter sand to the finished ground surface. All three wells were installed with a 5 feet tall protective, lockable casing approximately 2 feet into the grout/cement and 3 feet standing above the ground surface.

All three wells were then surveyed from the top of the casing thus enabling the calculation of the elevation of the potentiometric surface of the water table.

The following day, July 21, 1989, measurements were obtained from the top of the PVC casing (northern edge) to the groundwater for each of the three wells. The wells were then purged three times the volume of the liquid in the well in order to obtain a representative sample of the groundwater. Each groundwater sample was obtained with a 2 foot long teflon bailer with the water sample being placed into two 40 ml vials with teflon caps and two quart jars. The teflon bailer was decontaminated between sample locations with a blend of laboratory grade alconox soap and distilled water three separate times in order to prevent cross-contamination, then rinsed with distilled water. All samples were preserved in an ice filled cooler.

The samples were then dropped off at KAR Laboratory in Kalamazoo, Michigan on July 21, 1989.

3.0 ANALYTICAL RESULTS

The analytical results were received from KAR Laboratory on August 14, 1989. All the metals results are in parts per million (mg/L or mg/kg), while the volatile results are in parts per billion (ug/L or ug/kg). There are two areas that have elevated levels of contaminants. The first area concerns OW-1, next to the Auto Ion property. Two of the contaminants presently in the soil samples from OW-1, Tetrachloroethene and total Chromium, were also found to occur in soil borings on the Auto Ion property according to an August 12, 1988 report, "Remedial Investigation & Endangerment Assessment", Fred C. Hart Associates, Inc., 3000 Town Center, Suite 315, Southfield, Michigan. The groundwater from observation well #1 (OW-1) contained the following contaminants: Tetrachloroethene, 1200 ug/L; 1,1,1 Trichloroethane, 6.2 ug/L; Trichlorethene, 49 ug/L; and cis-1,2 - Dichloroethene, 21 ug/L. All of these chlorinated organics were also present at the same depth in soil borings on the Auto Ion property, according to the Hart report.

Upon reviewing the Hart report section on the hydrogeology of the Auto Ion site and determining groundwater flow on the PPC property, it is evident that the groundwater flow direction alters considerably based upon the level, and flow rate of the adjacent Kalamazoo River. The groundwater flows either southwesterly towards the Kalamazoo River or northwesterly towards the northeast edge of the PPC facility.

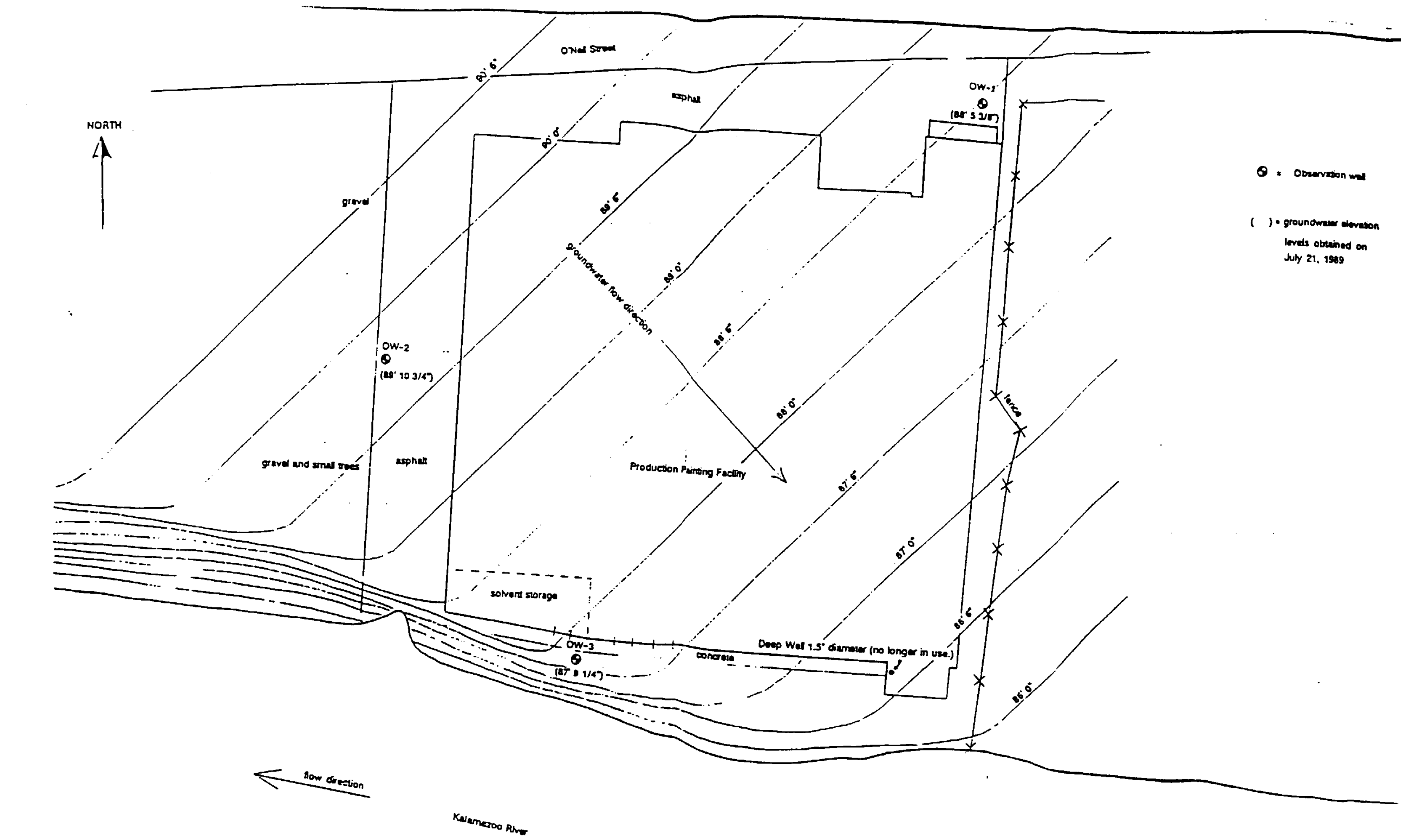
The groundwater sample from OW-2 appears to be "clean" except for the presence of 2.8 ug/L of vinyl chloride. The third observation, well, OW-3 contained the following volatile organics in the soil within 2 feet of the surface: Toluene, 5900 ug/kg; m/p - Xylene, 1500 ug/kg; O-Xylene, 620 ug/kg; 1,1 - Dichloroethane, 22 ug/kg; cis - 1,2 - Dichloroethene, 28 ug/kg; 1,1,1 Trichloroethane, 16 ug/kg; and Ethyl Benzene, 170 ug/kg. While the groundwater contained the following: Toluene, 100 ug/L; m/p - Xylene, 12 ug/L; O-Xylene, 6.7 ug/L; Trichloroethene, 4.5 ug/L; and cis - 1,2 - Dichloroethene, 1.6 ug/L.

The metals results for each location were not extremely high, however there were some elevated levels of Barium, Cadmium, Chromium, Lead and Arsenic.

4.0 CONCLUSIONS

Based upon the analytical results received, there are two areas of concern which should be addressed. The first concerns the area around OW-3 in which the Toluene has migrated down to the groundwater. A majority of the contaminants have stayed within two feet of the surface and would be easily excavated and removed. Any residual volatiles would be flushed out and removed by natural aeration.

The second area that needs to be addressed surrounds OW-1 in which it borders the Auto Ion facility. Some of the contaminants have migrated down to a depth of ten feet and entered the groundwater. Since all of the contaminants are also present on the Auto Ion property, it is highly probable that they migrated onto the PPC property by both surface run-off and groundwater migration.



Production Painting Company 1002 O'Neil Street Kalamazoo, Michigan	Observation Well Locations and Water Table Elevation Contours
August 7, 1989	

K&R Laboratories, Inc.

ANALYTICAL REPORT

To: MAECORP, Inc.
8180 Valley Point Dr.
Caledonia, MI 49316

Attn: Attn: Mr. Tom Raymond

Project No.: 891421
Client No.: 1876
Project Date: 7/21/89
Date Promised: 8/11/89
Date Reported: 8/11/89
PO#: 31149-MI-A071

Project Desc.: Analysis of water and soil samples.

Sample No.: 891421-04 Rec'd on: 7/21/89
Sample ID: OW-1, 4'-6', MI-A071 Soil

MDNR Scan 1 & 2	See attached
Arsenic, total	<10 mg/kg
Barium, total	<50 mg/kg
Cadmium, total	<0.5 mg/kg
Chromium, total	167 mg/kg
Copper, total	26 mg/kg
Lead, total	4 mg/kg
Mercury, total	<0.1 mg/kg
Selenium, total	<5 mg/kg
Silver, total	<0.1 mg/kg
Zinc, total	26 mg/kg

Unless otherwise noted, test results represent the sample(s) as they were received from client.

K&R Laboratories, Inc.

ANALYTICAL REPORT

To: MAECORP, Inc.
8180 Valley Point Dr.
Caledonia, MI 49316

Attn: Attn: Mr. Tom Raymond

Project No.: 891421
Client No.: 1876
Project Date: 7/21/89
Date Promised: 8/11/89
Date Reported: 8/11/89
PO#: 31149-MI-A071

Project Desc.: Analysis of water and soil samples.

Sample No.: 891421-06 Rec'd on: 7/21/89
Sample ID: OW-1, 8'-10', MI-A071 Soil

MDNR Scan 1 & 2	See attached
Arsenic, total	<10 mg/kg
Barium, total	<500 mg/kg
Cadmium, total	<0.5 mg/kg
Chromium, total	148 mg/kg
Copper, total	102 mg/kg
Lead, total	2 mg/kg
Mercury, total	<0.1 mg/kg
Selenium, total	<5 mg/kg
Silver, total	<0.1 mg/kg
Zinc, total	30 mg/kg

Unless otherwise noted, test results represent the sample(s) as they were received from client.

NEB Laboratories, Inc.

ANALYTICAL REPORT

To: MAECORP, Inc.
8180 Valley Point Dr.
Caledonia, MI 49316

Attn: Attn: Mr. Tom Raymond

Project No.: 891421
Client No.: 1876
Project Date: 7/21/89
Date Promised: 8/11/89
Date Reported: 8/11/89
PO#: 31149-MI-A071

Project Desc.: Analysis of water and soil samples.

Sample No.: 891421-05 Rec'd on: 7/21/89
Sample ID: OW-1, 6'-8', MI-A071 Soil

MDNR Scan 1 & 2	See attached
Arsenic, total	1 mg/kg
Barium, total	<50 mg/kg
Cadmium, total	<0.5 mg/kg
Chromium, total	1150 mg/kg
Copper, total	131 mg/kg
Lead, total	3 mg/kg
Mercury, total	<0.1 mg/kg
Selenium, total	<0.5 mg/kg
Silver, total	<0.1 mg/kg
Zinc, total	42 mg/kg

Unless otherwise noted, test results represent the sample(s) as they were received from client.

AUTO ION STEERING COMMITTEE

KALAMAZOO, MICHIGAN

FINAL

FEASIBILITY STUDY

FOR OPERABLE UNIT II

AUTO ION SITE

KALAMAZOO, MICHIGAN

PROJECT #684-03

November 1993

Office Location:

EDER ASSOCIATES CONSULTING ENGINEERS, P.C.
1st National Building
201 S. Main Street
Ann Arbor, Michigan 48104

Office Contact:

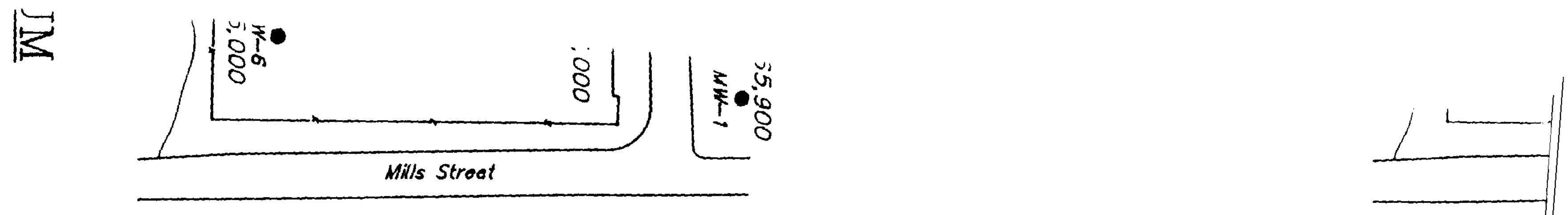
Edward C. Burk, Jr.
(313) 663-2144

Offices in New York, Wisconsin, Georgia, Florida, and New Jersey

APPENDIX C

DRAWING 1

MEAN CONCENTRATIONS OF ELEVATED GROUNDWATER ANALYTES ALONG EASTERN PORTION OF SITE



AUTO ION SITE

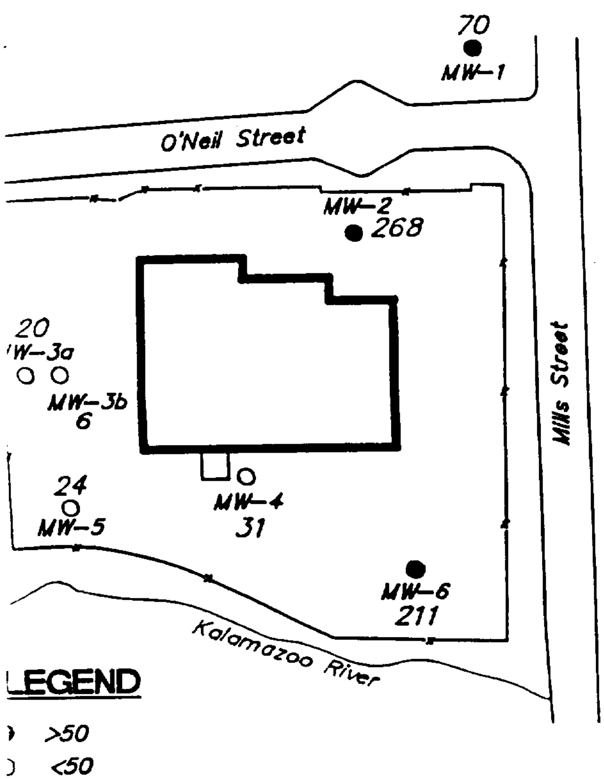
KALAMAZOO, MICHIGAN

eder associates consulting engineers, p

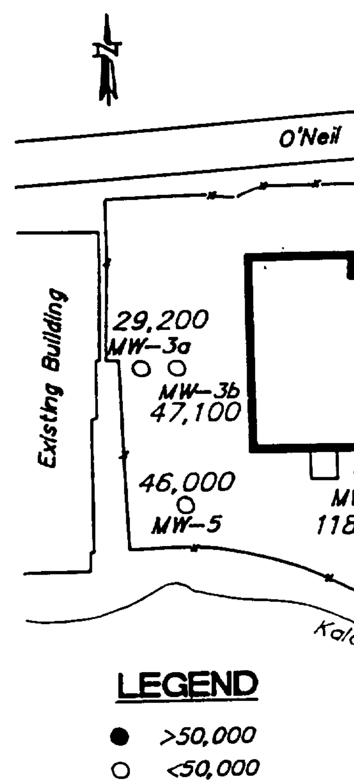
NEW YORK WISCONSIN MICHIGAN GEORGIA FLORIDA NEW JERS

BERYLLIUM

CAD



LEAD



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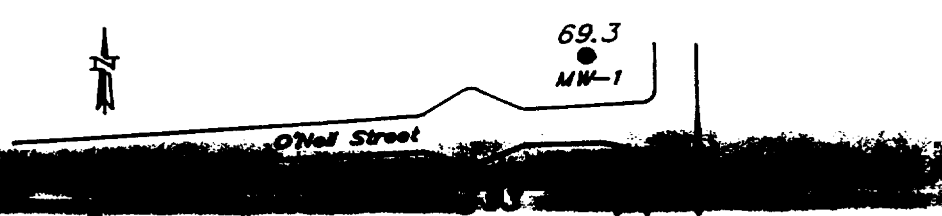
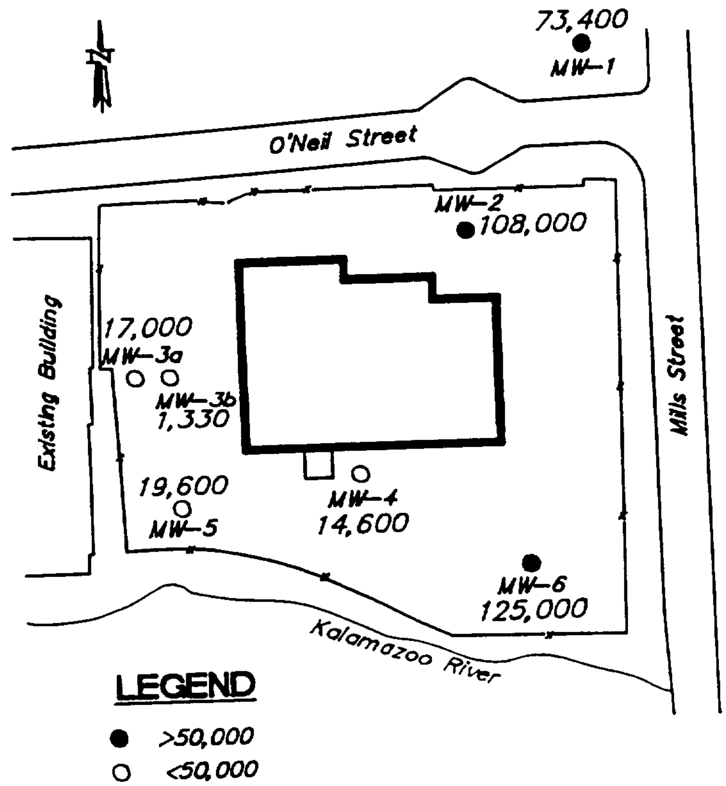
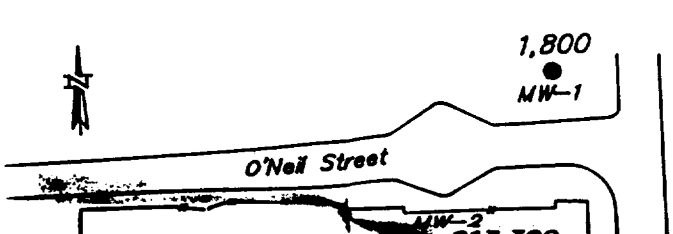


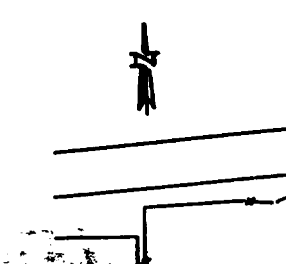


73,400
MW-1
O'Neil Street
MW-2
108,000
Existing Building
17,000
MW-3a
MW-3b
1,330
19,600
MW-5
MW-4
14,600
MW-6
125,000
Mills Street
Kalamazoo River
LEGEND
>50,000
<50,000

IRON



1,800
MW-1
O'Neil Street
MW-2

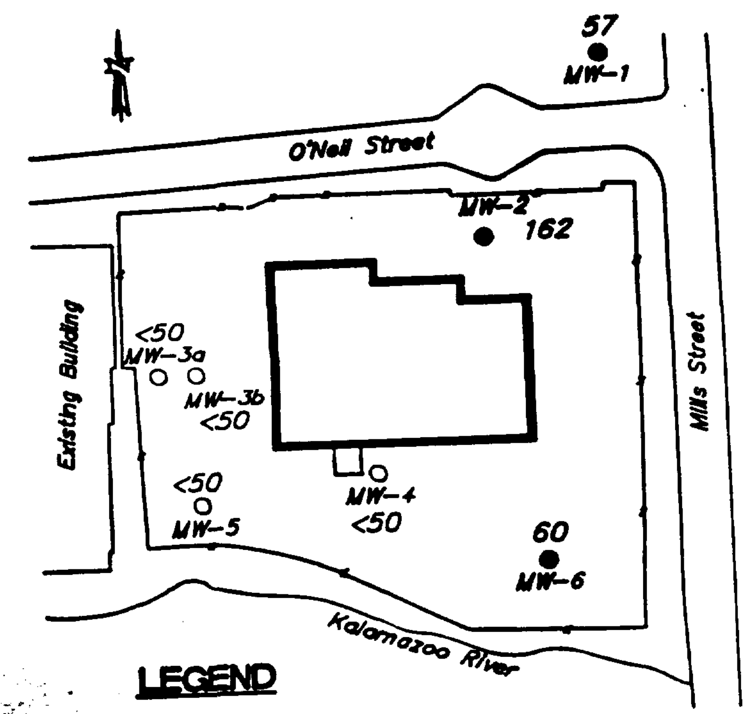


LEGEND

● >10,000

○ <10,000

ALUMINUM



LEGEND

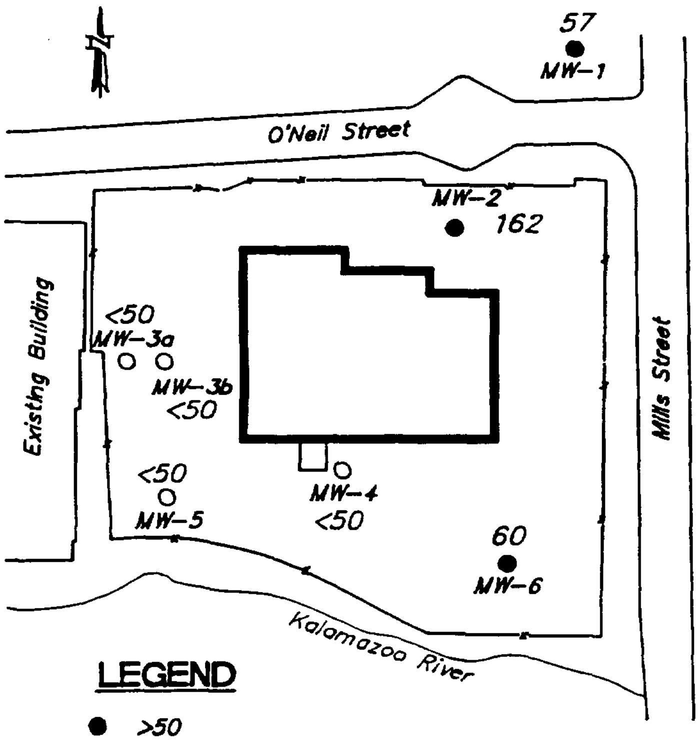
● >50

○ <50

COBALT

● >10,000
○ <10,000

ALUMINUM



LEGEND

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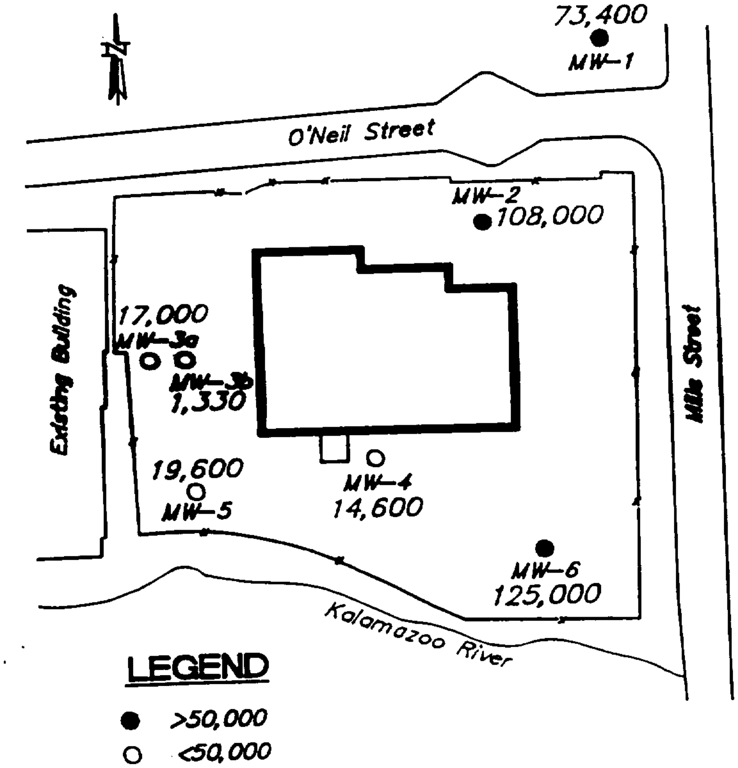
○ <50

COBALT

○ <200

BARIUM



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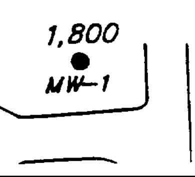

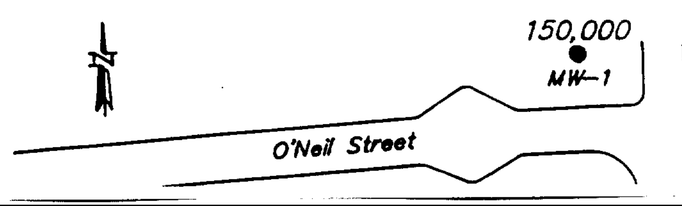

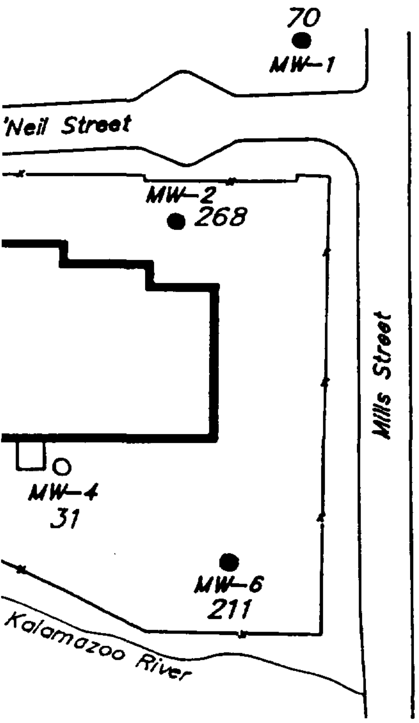

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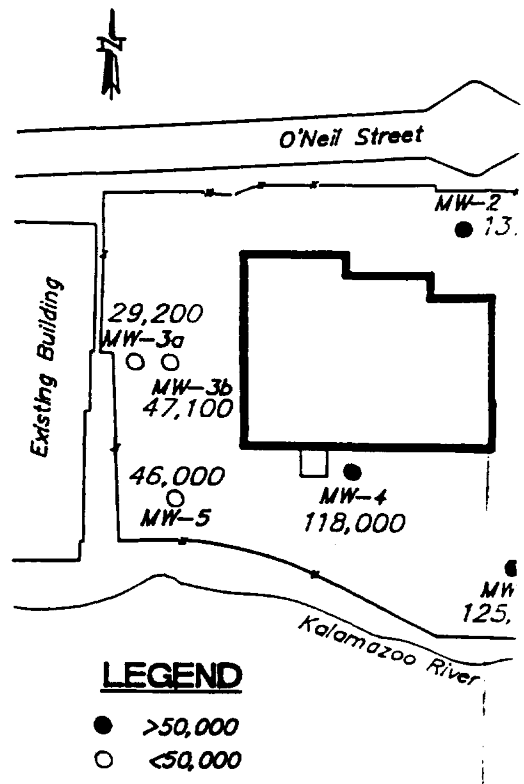

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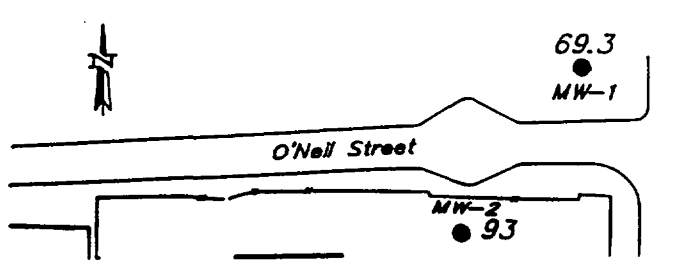


AUTO ION SITE

KALAMAZOO, MICHIGAN

...tes consulting engin...

NEW YORK ... MICHIGAN GEORGIA FLORIDA

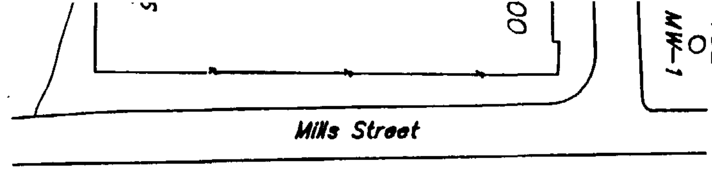
PROJECT

AUTO ION SITE
KALAMAZOO, MICHIGAN

APPENDIX D

DRAWING 2

MEAN CONCENTRATIONS OF ELEVATED GROUNDWATER ANALYTES ALONG EASTERN PORTION OF SITE



AUTO ION SITE

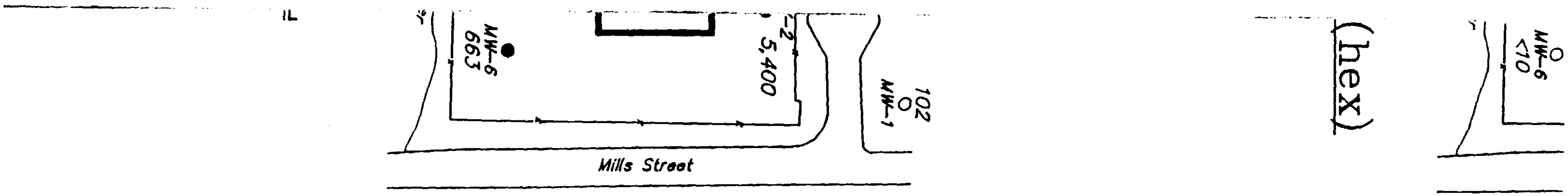
KALAMAZOO, MICHIGAN

eder associates consulting engine

NEW YORK WISCONSIN MICHIGAN GEORGIA FLORIDA

PROJECT

AUTO ION SITE

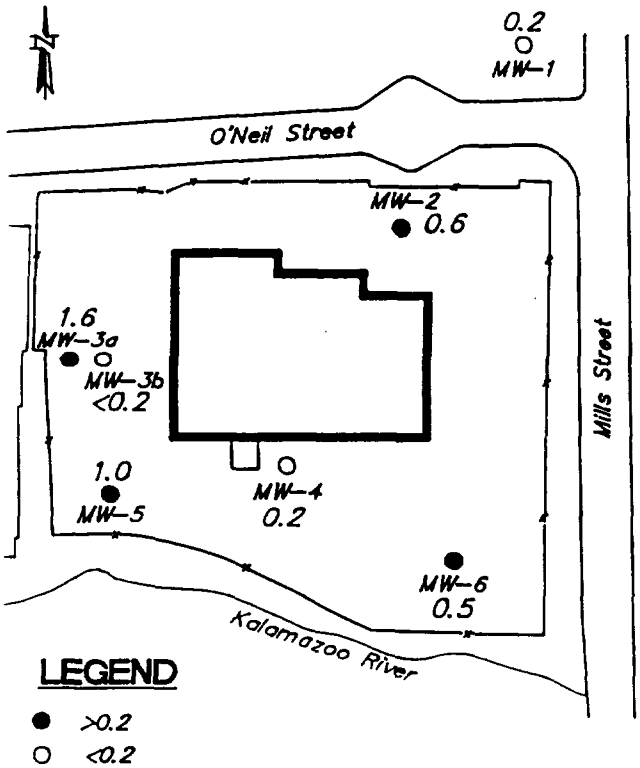


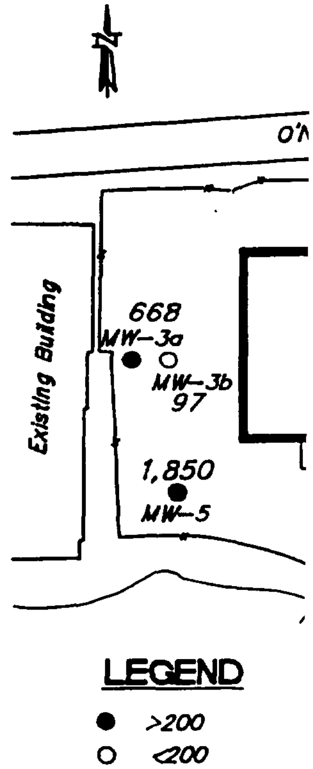
AUTO ION SITE

KALAMAZOO, MICHIGAN

CHROMIUM (total)

CHROM

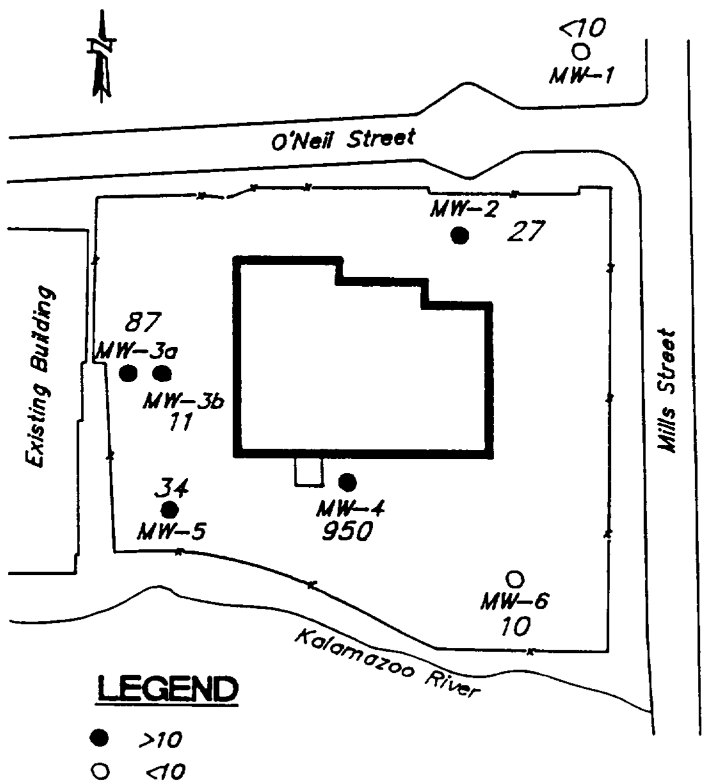




MERCURY

N

CALCIUM



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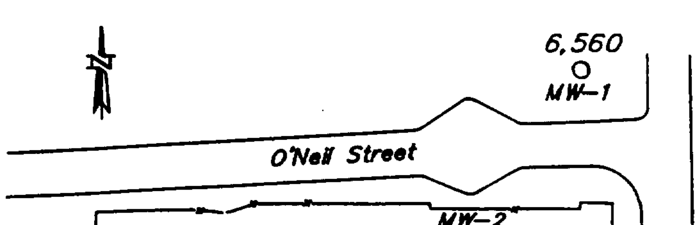
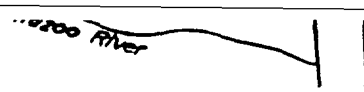
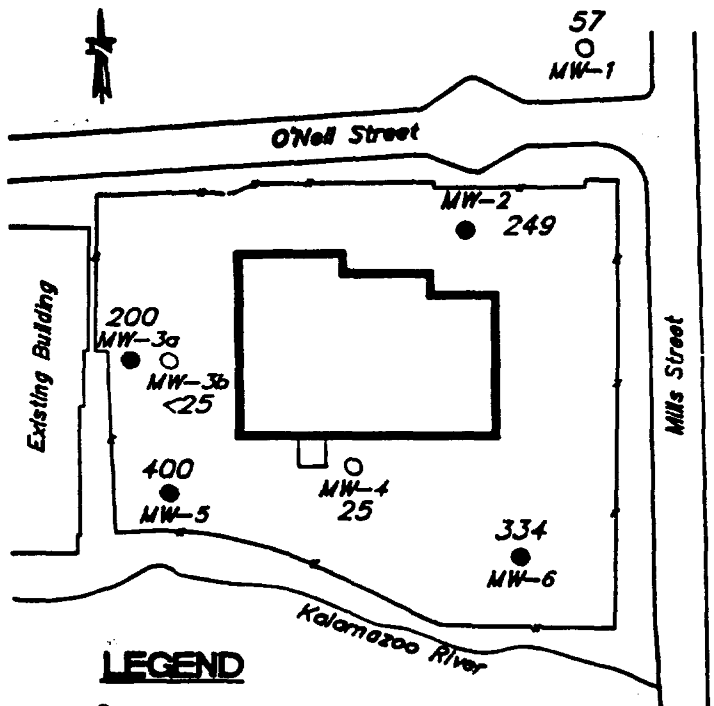




LEGEND

● >10
○ <10

ARSENIC



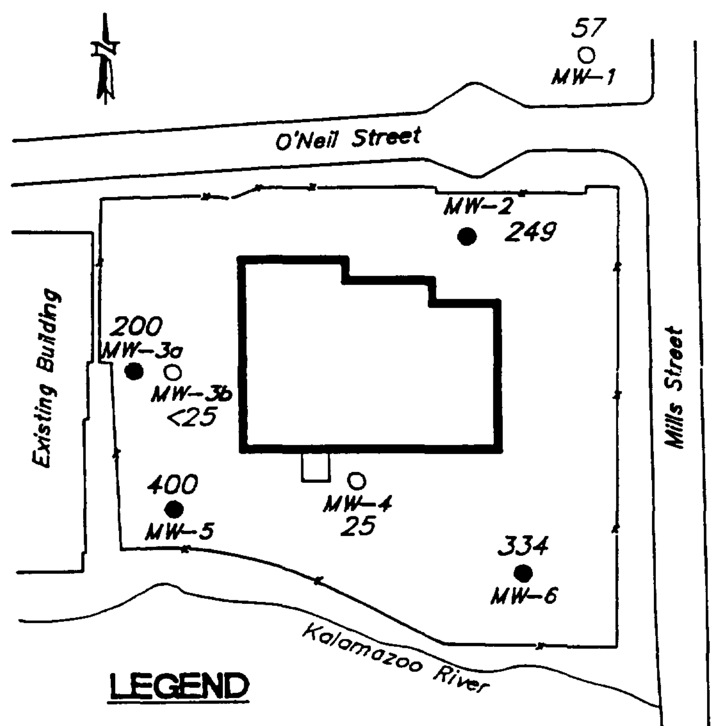
LEGEND

● >100
○ <100

COPPER

● >10
○ <10

ARSENIC



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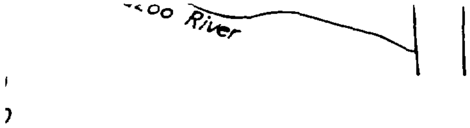
○ <100

COPPER

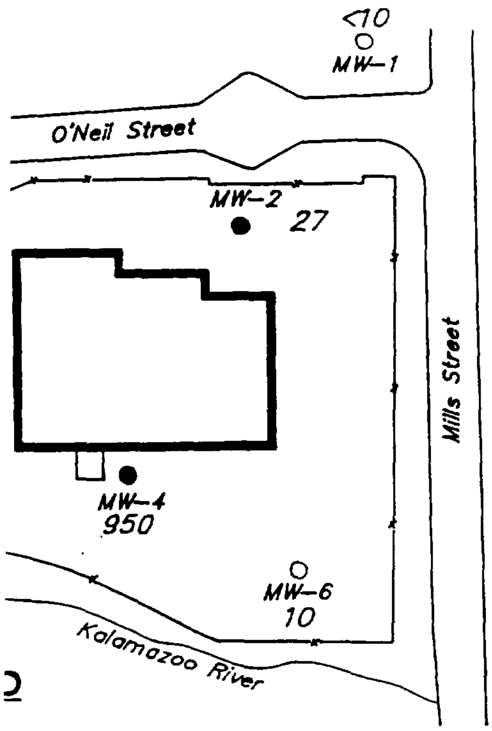


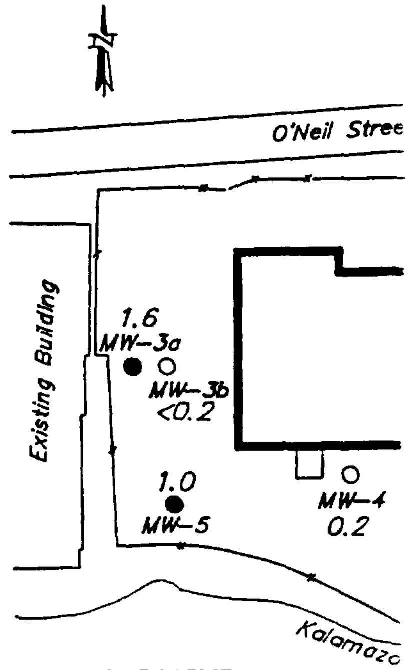
LEGEND

- ● >100
- ○ <100

CALCIUM

CHROMIUM





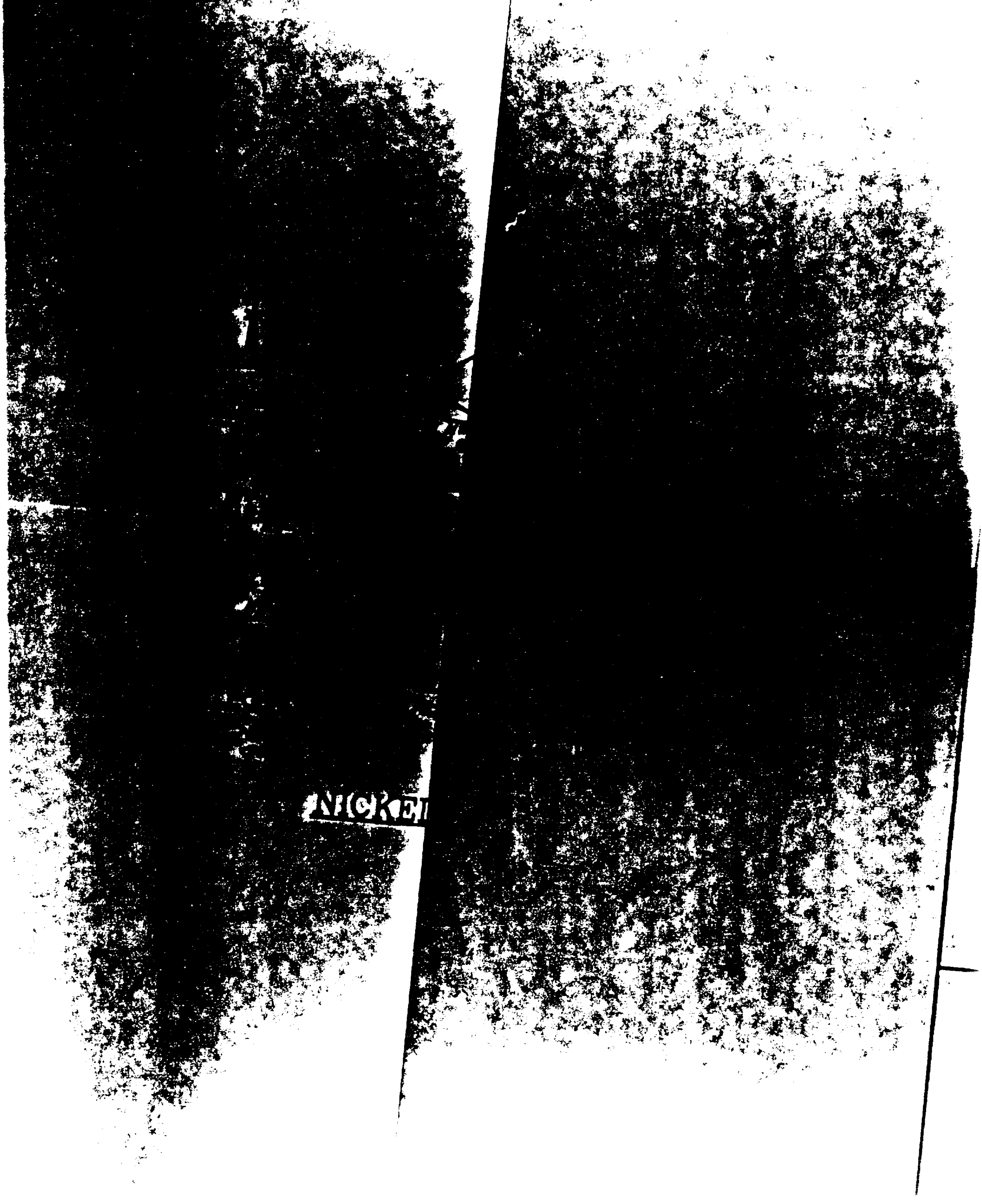
LEGEND

- ● >0.2
- ○ <0.2

CYANIDE

MERC

CHROMIUM (hex)



TITLE

AUTO ION SITE
KALAMAZOO, MICHIGAN

PROJECT

AUTO ION SITE

KALAMAZOO, MICHIGAN

eder associates consulting en

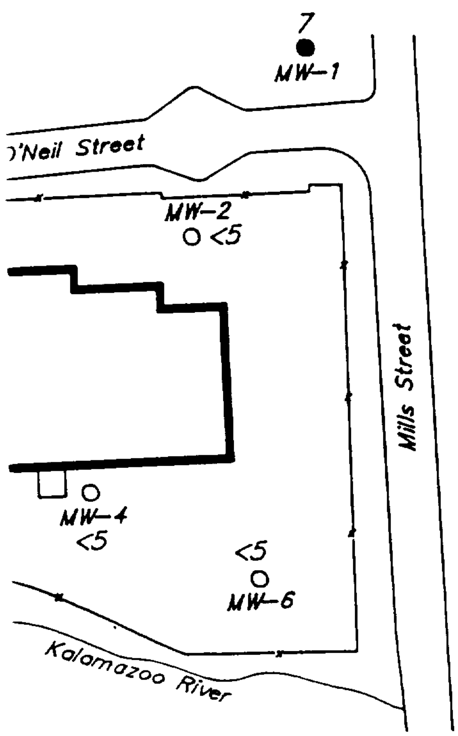
NEW YORK WISCONSIN MICHIGAN GEORGIA FLOR

APPENDIX E

DRAWING 3

MEAN CONCENTRATIONS OF ORGANICS IN GROUNDWATER

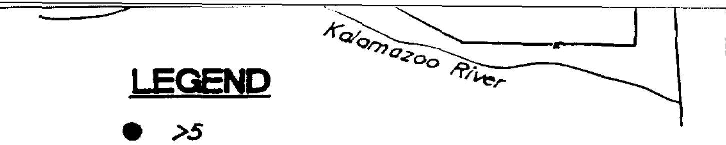
ILOROETHANE



CHLOROETHENE

AUTO ION SITE
KALAMAZOO, MICHIGAN

PROJECT



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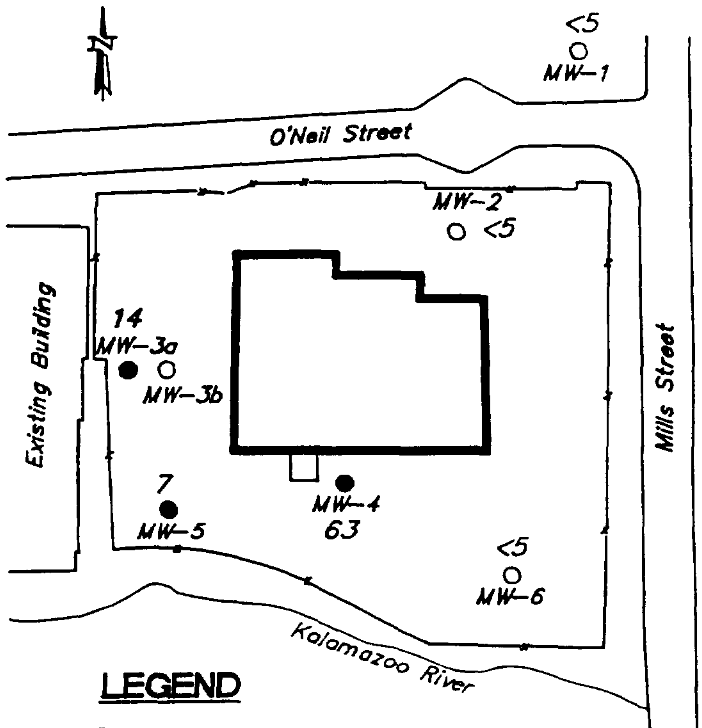

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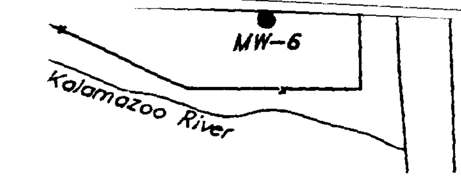

ROMETHANE

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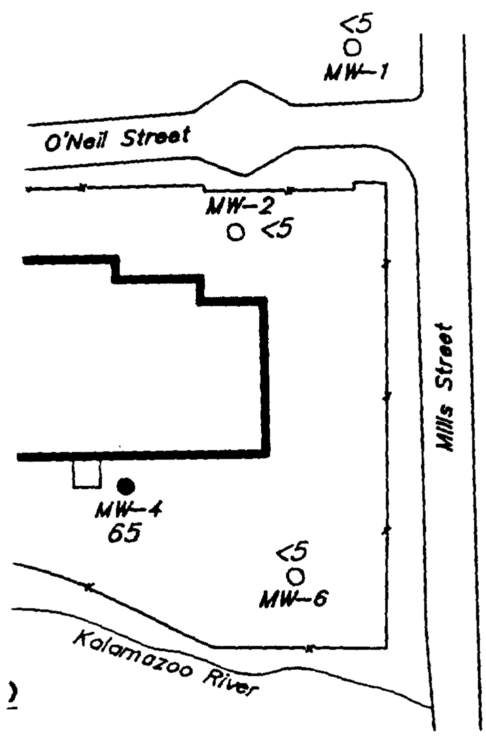

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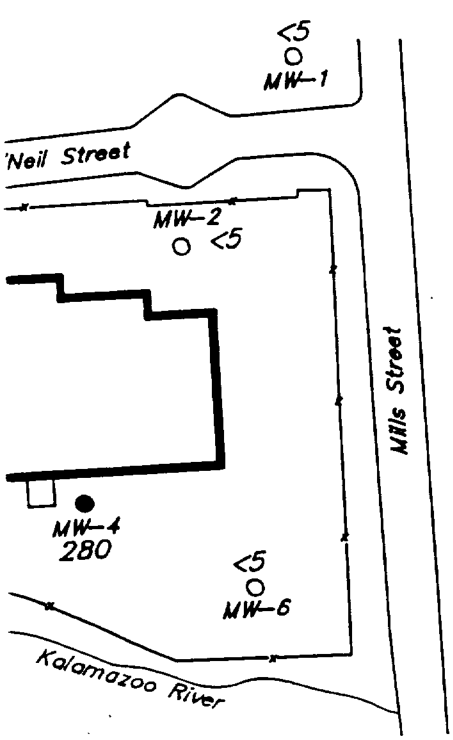
OROBENZENE



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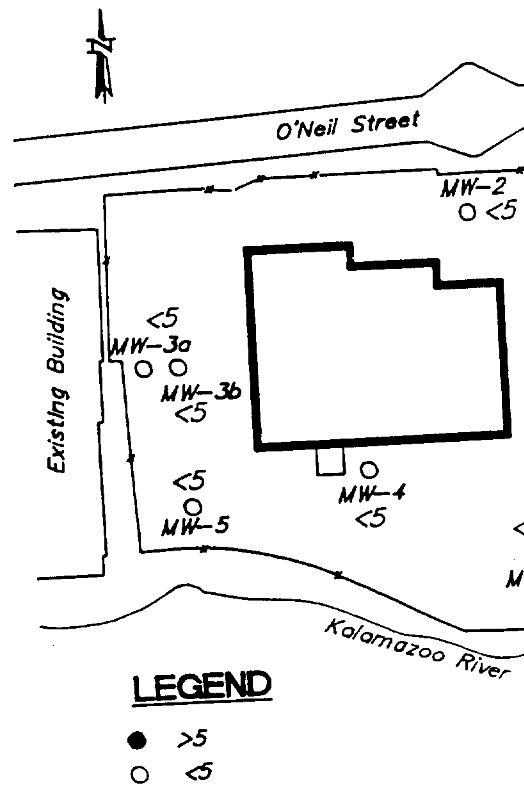

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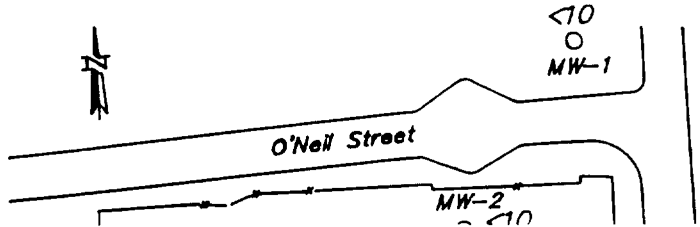

APPENDIX F

REMOVAL TIME FRAME ANALYSIS

Chemical Removal Timeframe Analysis

Prepared for:

eder associates
Auto-Ion PRP Group

Prepared by:
Conestoga-Rovers & Associates
2 November 1993

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CHEMICAL REMOVAL TIMEFRAME ANALYSIS

1.0 INTRODUCTION

This report presents an analysis of the time required to remove specific chemicals from the subsurface soils and groundwater at the Auto-Ion site. Kalamazoo. Michigan. The purpose of this analysis was to evaluate the time needed to remove specific chemicals from the groundwater flow system under natural flushing conditions and compare these times to the flushing rates calculated for a remedial pumping system. This was done using nickel as an indicator chemical. This analysis was conducted by Conestoga-Rovers & Associates. as authorized by Eder Associates and the Auto-Ion site PRP Group, as part of the feasibility study for operable Unit II.

1.1 Site Background

The City of Kalamazoo. Michigan operated an electrical generating station at the Auto-Ion site location from the 1940s until 1956. In 1956 Consumers Power Company purchased the generating plant. and shortly thereafter closed and dismantled the facility.

The Auto-Ion Chemical Company (AICC) initiated operations at the site in 1964. Initial operations involved industrial wastewater treatment activities, specifically the treatment of electroplating wastes. AICC received waste materials containing chrome and cyanide. The treatment operations involved destruction of the cyanide and precipitation of heavy metals. The sludge from the precipitation operations were disposed in an on-site lagoon. AICC activities ceased in 1973. Waste materials. both containerized and uncontainerized, remained at the facility after cessation of operations.

The site was placed on the National Priorities List in 1982. A ground surface clean-up at the site was conducted in 1983 by OH Materials Corporation on behalf of a certain number of the Potentially Responsible Parties. Following this general clean-up activity, the building that was on-site was demolished under the direction of the City of Kalamazoo. From that time until the present day the surface of the site has remained essentially unchanged.

During 1987 and 1988 a remedial investigation was conducted to define the subsurface soil and groundwater conditions at the site. This investigation defined the geologic, hydrogeologic and chemical conditions. These RI data were reviewed to obtain an understanding of subsurface conditions and to provide input to this chemical flushing analysis.

1.2 Objectives of Chemical Transport Assessment

The objectives of this assessment were to develop information on the rate at which specific chemicals would be flushed from the subsurface soil and groundwater at the Auto-Ion site. Specifically, the rate at which these chemicals would be flushed under natural flow conditions was assessed, and in addition, an assessment of clean-up time-frames associated with a remedial program was also conducted using nickel as an indicator chemical.

2.0 GENERAL SITE CONDITIONS

The remedial investigation program indicated that some organic compounds and numerous inorganic metals were present in the soil and groundwater system beneath the Auto-Ion site. An assessment of risk associated with the detected compounds was conducted as part of this feasibility study. This risk assessment is described in Section 1.2.6. Table 1-8 entitled "Chronic Non-Carcinogenic Risk Levels for Use of Groundwater as Residential Drinking Water" is contained in this section. This table identifies that nickel accounts for half of the chronic non-carcinogenic risk. This factor, in conjunction with the fact that nickel transport conditions have been documented in the literature, resulted in the selection of nickel as the indicator of chemical transport at the site for purposes of comparing the time-frames for natural flushing conditions and remedial pumping conditions.

2.1 Site Lay-out and Geology

The Auto-Ion site area is shown in Figure 1. This figure also identifies the location where borings/monitoring wells were installed to investigate subsurface conditions.

Soils to a depth of 100 feet were deposited by glacial outwash processes. The boring and well logs for the site, as well as laboratory grain-size analyses of selected soil samples confirm that these soils are glacial outwash deposits. These soils are described as interbedded gravels, sands and silts. Lenses of silty clay material and a layer of black clay/peat were also reported. These types of interbedded deposits are characteristic of glacial outwash materials. These interbedded deposits constitute the aquifer soil materials.

Figure 2 shows the location of two subsurface cross-sections. Figure 3 shows the cross-section through the eastern portion of the site. Overall, subsurface conditions can be described as sandy materials extending to a depth of approximately 100 feet. A fill overlies this sandy material to a depth of approximately 5 to 8 feet below ground surface. Gravel, as well as silt/clay, was also present in the sandy aquifer materials. The southern portion of the site adjacent to the River appears to have a small lense of black clay/peat material near the top of the sandy deposits. This black clay/peat lense lies immediately below the top of the groundwater table.

The cross-section on the western portion of the site is shown in Figure 4. This cross-section shows basically the same site conditions as noted in the previous section, with the exception of the presence of a gray silt/clay layer at a depth of approximately 17 to 27 feet. This silt/clay lense appears to be present in the north-western and west central portions of the site area and pinches out toward the River. The lense of black clay material adjoining the Kalamazoo River is also present in this section on the southern portion of the site. It appears that this clay lense is relatively contiguous at the top of the groundwater table along the site boundary adjoining the Kalamazoo River.

Soil borings B-1 and B-3 were drilled to depths in excess of 100 feet. These borings show that the aquifer soil materials are underlain by a shale bedrock which was encountered at a depth of 97 feet (B-3) and 109 feet (B-1).

2.2 Site Hydrogeology

The aquifer beneath the facility is unconfined, extending to a depth of approximately 100 feet. The top of the groundwater table is in the range of 5 to 10 feet below ground surface, and the saturated flow thickness is roughly 90 to 95 feet.

Groundwater level data collected during conduct of the remedial investigation indicate that flow is generally toward the Kalamazoo River. The groundwater table itself is relatively flat, having generally less than one-half foot of relief across the entire site area.

Groundwater movement is predominantly horizontal beneath the site area under normal flow conditions. Figure 5 shows a cross-section through the site area and illustrates the stream lines of groundwater flow. Groundwater in the upper portion of the aquifer is essentially horizontal across the entire site area. Groundwater flow in the deep portion of the aquifer is predominantly horizontal, moving more vertically with proximity to the River.

The groundwater flow stream lines shown in Figure 5 were generated by the FLONET numerical code using the hydraulic properties and boundary conditions that generally describe the Auto-Ion site area. A complete discussion of this model and the boundary conditions as well as input parameters are contained in Appendix I of this feasibility study.

2.3 Groundwater Quality

A complete discussion of groundwater quality is contained in the remedial investigation report, and is summarized in this feasibility study document (Section 1.0). The average concentration of nickel reported to be present in the groundwater flow system measured at monitoring wells 2 through 6 is illustrated in Figure 6. The average concentration of nickel, based upon these data, is 3,000 micrograms per liter and the nickel concentration at the 95% upper confidence limit is 5590 micrograms per liter. For the purposes of this analysis, the 95% upper confidence limit was utilized.

The data indicate that nickel is present throughout the entire site area, and therefore, flushing would have to occur horizontally over the length of the entire aquifer cross-section beneath the site to remove it. This flushing distance is approximately 250 feet.

3.0 SOLUTE TRANSPORT MODEL

The analysis of groundwater chemical transport for the Auto-Ion site was conducted using the one-dimensional chemical migration model, "POLLUTE" (Version 5.0). This model was developed by the Geotechnical Research Center at the University of Western Ontario, London, Ontario. This numerical code was designed to calculate the concentration of chemicals throughout aquifer soil materials over time.

The model considers the contaminant transport mechanisms of diffusion, dispersion and advection. Since the model is one-dimensional, it is most appropriately applied to the assessment of a geologic layer where the direction of chemical transport is in one dominant direction, such as chemical movement along a horizontal flow path.

The POLLUTE modeling code implements a solution to the one-dimensional dispersion, advection equation for a layered deposit of finite or infinite extent, and includes the following capabilities/features:

- The mass flux of chemicals moving through the geologic unit are calculated,
- The concentration of chemicals in the geologic unit are reported, and
- The effects of sorption/desorption of the chemical is considered.

Two assumptions that the model makes are that sorption and desorption are identical processes, and the desorption process is instantaneous. That is, desorption is a mirror image of the sorption process and it occurs instantaneously. Under actual field conditions, this is not the case. When chemicals are sorbed onto soil materials, the driving force for sorption is relatively high since the chemicals are moving from a dissolved water phase onto soil particles that are initially devoid of any foreign chemical presence. Desorption is not the exact reverse of this process. Furthermore, desorption occurs over a finite time-frame and is not instantaneous. Overall, these assumptions mean that predicted desorption times will be shorter than what would actually occur in the field.

A complete description of the POLLUTE model can be obtained from the Geotechnical Research Center, Faculty of Engineering Science, The University of Western Ontario, London, Ontario, Canada. The reference report number for this document is GEOP 90-1.

4.0 SOLUTE TRANSPORT ANALYSIS

The migration of nickel horizontally through the groundwater flow system was assessed for both natural flow conditions as well as groundwater flow conditions that would be induced if a remedial pumping program were installed. The specific conditions of groundwater flow for both of these conditions were derived from the remedial investigation data and the modeled assessment of groundwater flow conducted as part of this feasibility study (Appendix I). The chemical transport analysis was accomplished through use of the POLLUTE modeling code.

The model layout and input conditions are identified in Figure 7. The overall length of the aquifer from which nickel must be flushed is approximately 250 feet. This is the width of the site from O'Neil Street to the Kalamazoo River. The initial nickel concentrations for groundwater in the site area were taken from the remedial investigation data, specifically the 95% upper confidence level of approximately 5,600 micrograms per liter was utilized in this analysis. The seepage velocity for the groundwater flow was based upon an overall site hydraulic conductivity of 1 x 10^{-2} cm. per sec. and was estimated at 0.1 feet per day.

The sorption capability of nickel for various soil types has been researched by several investigators. The Electric Power and Research Institute (EPRI) has compiled this type of information for chemicals related to the electric power industry. This compilation[1] contains information on the movement of nickel in soil and groundwater. These data were reviewed and the sorption constants for the Freundlich isotherm developed by Bowman. et al. (1981) were utilized in this analysis.

Nickel sorption and transport information was compiled for numerous types of soil materials by Bowman. The Auto-Ion site conditions show that the coarser grained soils contain some silt and clay material and interbeds of silt/clay also occur in the aquifer soils. Sorption coefficients were selected from the published data for soil materials corresponding to these soil types. Table 1 identifies these parameters.

---

[1]"Chemical Attenuation Rates, Coefficients, and Constants in Leachate Migration. Volume I: A Critical Review". EPRI PA-3356. February 1984.

TABLE 1

Nickel Sorption Information

Soil Type	Sorption Coefficient K_f (ml/g)	Freundlich Exponent (1/N)
Sandy Soils	0.24	0.92
Silt/clay	0.65	0.99

Sorption/desorption was analyzed using the Freundlich isotherm, which is stated as:

$$S = K_f C^{1/N}$$

Where,

K_f = sorption coefficient (ml/g)

C = Chemical concentration of the aqueous phase (g/ml)

1/N = Freundlich exponent (dimensionless)

S = Mass of solute removed from solution (sorbed) per unit mass of solid (fraction)

Chemical transport conditions were first analyzed for a sandy aquifer only, and then combined conditions for a sandy material containing silt/clay were evaluated.

4.1 Chemical Transport in Sandy Soil Materials

The sorption/desorption information presented in Table 1 for sandy soil materials was utilized in conjunction with the input conditions identified in Figure 7 to assess chemical transport through sandy soils at the Auto-Ion site. The resultant desorption chemical transport curve for nickel is shown in Figure 8. This graph illustrates the decline of nickel concentrations in the groundwater beneath the Auto-Ion site due to flushing by natural groundwater flow conditions. If it is assumed that groundwater concentrations of nickel must be reduced to 100 micrograms per liter. flushing of the aquifer would need to occur for 30 to 35 years to achieve this level.

If a remedial system were installed. the seepage velocity of groundwater would be increased. and it is possible that chemicals could be removed from the aquifer at a faster rate. This possibility can only be realized if the rate of desorption of chemicals is instantaneous. In reality, desorption of chemicals requires some finite time. and therefore. while the speed of aquifer flushing may be partially increased. the increase will not be linear. The POLLUTE model. however. assumes that the desorption process is instantaneous. Therefore. the model will show that an increase in groundwater seepage velocity results in a proportionate increase in chemical flushing. This condition is very conservative because desorption of chemicals under actual field conditions does not occur instantaneously.

Given the assumptions incorporated in the model. it is expected that the model results will indicate a faster rate of groundwater clean-up when the seepage velocity of groundwater flow is increased. such as by implementation of a remedial pumping system. Figure 9 shows the desorption curve for remedial pumping conditions in a sandy aquifer. As can be seen, nickel concentrations are reduced below 100 micrograms per liter in a period of approximately 10 to 15 years. These flushing conditions apply only to a sandy aquifer, assuming clay/silt materials are not present.

4.2 Chemical Transport in Silt/Clay

The Auto-Ion site conditions indicate that the sandy aquifer soil materials contain silt/clay. Figure 4, the west side geologic cross-section through the site area, shows a significant lense of silt/clay material present in the western and northwestern portions of the site area. In addition, the boring logs and mechanical grain-size analyses reported in the remedial investigation indicate the presence of silt/clay lenses and silt/clay material in the geologic profile. These silt/clay interbeds are not an unusual occurrence in glacial outwash geology. Rather, their occurrence is normally expected.

The finer grained silt/clay materials will have a higher potential to sorb and retain chemicals such as nickel as compared to the coarser grained sandy soil materials, because a larger surface area for sorption is provided by the finer grained soils. This is a generally understood principle of contaminant transport and is also reflected by the higher sorption coefficient for silty/clay materials listed in Table 1.

Since silt/clay is present in the aquifer soils at the Auto-Ion site, its impact on chemical transport and chemical flushing needs to be considered. The amount of silt/clay and frequency of occurrence of silt/clay lenses in the geologic profile is an important consideration when assessing this impact. The boring logs themselves do not provide a sufficiently detailed description of the geologic conditions from which an exact occurrence frequency for the silt/clay lenses can be calculated. The boring logs for the Auto-Ion site were prepared in accord with geotechnical engineering standards. and typically such interbeds are not recorded. The descriptions do. however. indicate the presence of silt/clay and can be used to quantify the general percentage of silt and clay in the aquifer soil materials.

The cross-section of site geology as well as the mechanical grain size analyses for the sandy soil materials and the boring logs provide insight into the occurrence frequency of silt/clay in the aquifer skeleton. The general geologic profile shows a 10 foot thick lense of silt/clay in a total aquifer thickness of 100 feet. In addition. the mechanical grain size analyses. together with the boring log descriptions. indicate that silt/clay materials comprise approximately 15% of the total aquifer skeleton. The impact of silt/clay lenses on chemical transport for the silt/clay material was considered to be 10% of the overall chemical transport conditions in order to present a conservative assessment.

The desorption of nickel from silt/clay soil materials is shown in Figure 10. As can be seen. the time-frame for flushing of nickel from these finer grained soils is significantly longer than the time-frame related to flushing of nickel through the coarser grained sandy soils. This condition is consistent with the physical/geochemical properties of these two soil types. considering the fine grained nature of the silt/clay and the inherently slower rate of water flow through these finer grained soils. In addition. the sorption capacity of the silt/clay material is greater than the sandy material (see Table 1) which is consistent with the longer flushing term condition.

The length over which flushing must occur from a silt/clay lense is much shorter than the entire width of the site area. Advective flow would tend to be horizontal along the length of the silt/clay lense and chemicals would also disperse laterally (vertically) outward. The resultant chemical movement would be at an oblique angle to the horizontal. Considering these factors, the length of the silt/clay lense flow path was taken as one foot.

The rate of flushing of nickel from the silt/clay layer was also assessed to determine its sensitivity to different seepage velocities (hydraulic conductivity conditions). In addition to the seepage velocity of 1×10^{-5} feet per day utilized for development of the desorption curve illustrated in Figure 10, seepage velocities one order of magnitude lower and one order of magnitude higher were also evaluated. These three seepage velocities correspond to hydraulic conductivities in the range of 10^{-5} cm. per sec to 10^{-7} cm. per sec., which is consistent with the range of permeabilities expected for silt/clay materials. The desorption curves for all three seepage velocities are shown in Figure 11. These desorption curves show that while effective groundwater movement through silt/clay layers may have some impact, the primary mechanism of chemical transport is diffusion. Thus, it can be seen that the dissipation of nickel from silt/clay materials is not primarily dependent upon the speed of groundwater flow, but is linked to the rate of chemical diffusion.

4.3 Chemical Transport in an Aquifer With Sandy Soils Containing Silt/Clay

The natural dissipation of nickel through sandy soil materials is shown in Figure 8, and the dissipation of nickel through silt/clay soils is shown in Figure 10. These two desorption curves must be integrated in order to obtain a curve for natural nickel dissipation in an aquifer composed principally of sandy soils with a little silt/clay material. The sandy soils provide a 90% contribution to nickel transport/retardation, and the silt/clay provides only a 10% contribution to nickel transport/retardation. Thus, the sand desorption curve must be weighted at 90% and the silt/clay curve at 10%.

Table 2 provides a tabulation of desorption curve data for both the sandy materials and the silt/clay material. These data have been integrated using a weighted averaging technique so that the silt/clay data only contributes 10% to the combined desorption curve. The column of combined data is the resultant desorption information, and is graphed in Figure 12. This curve shows that nickel would be flushed from the Auto-Ion site under natural flow conditions in approximately 50 to 60 years.

A similar assessment was conducted for remedial pumping conditions in a sandy aquifer containing silt and clay materials. The previously discussed desorption curve for remedial flow conditions in a sandy aquifer is shown in Figure 9. The increased groundwater seepage velocities induced by the remedial system caused the nickel to be flushed at a faster rate from the groundwater aquifer. Enhanced removal of nickel due to increased seepage velocities, however, does not occur in silt/clay materials. This is graphically illustrated in Figure 11 where seepage velocities with a 10 to 100 times variance have a minimal impact on the rate at which nickel is flushed from the silt and clay material. Therefore, the desorption curve for nickel from the silt/clay material will be the same for natural flushing conditions as they are for remedial flow conditions. Thus, the desorption curve for silt/clay illustrated in Figure 10 would also be applicable for this assessment of nickel transport through sandy aquifers containing silt/clay materials under remedial pumping conditions.

The desorption data for Figures 9 and 10 are listed in Table 3. Again, the desorption data for each soil media were averaged using the weighting technique described above and the combined listing from Table 3 is graphed in Figure 13. These data show that under remedial pumping conditions, the time for flushing of nickel from the site area is approximately 50 to 60 years, the same time-frame needed for flushing of nickel from the aquifer without a remedial program installed.

The primary factor controlling the time-frame for flushing of nickel from the Auto-Ion site is the presence of silt/clay. Removal of chemicals such as nickel from the aquifer will require the same amount of time, with or without a remedial program installed.

In the above analysis, nickel is used as an indicator. Most other inorganics present at the Auto-Ion site would be expected to behave similarly to nickel. Desorption of organic chemicals may proceed at a faster rate than nickel, but would not generally be expected to proceed at a slower rate than nickel.

5.0 IMPACT OF OPERABLE UNIT I

The history of the Auto-Ion site shows that AICC initiated operations at the facility in 1964 and disposed metal plating waste materials in an on-site lagoon until 1973. Leaching of the metals from the surficial fill materials into the aquifer is a reasonable scenario with respect to chemical movement in the site area. It is also reasonable to conclude that this leaching action is a continuing process as long as the surficial soil materials containing chemicals are present.

Operable Unit I is focused to the removal of these near-surface soil materials containing chemicals. At the completion of Operable Unit I, flushing of the aquifer will commence. Within the first five years of this flushing action, a decrease in chemistry should be observed in the monitoring wells adjacent to O'Neil Street. This reduction in chemical concentration will occur most rapidly in these wells closest to the upgradient edge of the site and will progress across the entire site area with time.

6.0 CONCLUSIONS

Based upon the foregoing analysis. it is concluded that the primary factor associated with flushing of chemicals such as nickel from the groundwater aquifer at the Auto-Ion site is the presence of silt/clay in the groundwater aquifer. Desorption of chemicals such as nickel from these types of soil materials is a relatively lengthy process and controls the time required for site clean-up.

If no remedial program is installed at the site. and chemicals are allowed to naturally flush from the environment. site clean-up is projected to occur in a time-frame of 50 to 60 years on the basis that chemicals such as nickel will require the most time to desorb from the aquifer soil material. If a remedial program is installed and groundwater flushing through the sandy material is enhanced. desorption of chemicals from the silt/clay material will still control the time for clean-up for chemicals such as nickel and the projected time-frame will remain at 50 to 60 years. Therefore. the implementation of a remedial program will not speed-up the site clean-up time table.

TABLES

TABLE 2

Nickel Flushing Data for Natural Groundwater Flow

Year	Sand	Silt/Clay	Combined
0	5,600	5,600	5,600
5	5,549		
10	4,048	4,611	4,104
15	1,968		
20	798	3,303	1,049
25	301		
30	110	2,357	335
35	39		
40	14	1,682	181
45	5		
50	2	1,201	122
55	1		
60	0	857	86
65	0		
70	0		
75	0		
80	0	436	44
90	0		
100	0	222	22
125	0	96	10
150	0	41	4
175	0	18	2
200	0	8	1
250	0	1	0
300	0	0	0

NOTE: All concentrations in micrograms per liter

TABLE 3

Nickel Flushing Data for Remedial System Groundwater Flow

Year	Sand	Silt/Clay	Combined
0	5,600	5,600	5,600
5	1,968		
10	110	4,611	560
15	5		
20	0	3,303	330
25	0		
30	0	2,357	236
35	0		
40	0	1,682	168
45	0		
50	0	1,201	120
55	0		
60	0	857	86
65	0		
70	0		
75	0		
80	0	436	44
90	0		
100	0	222	22
125	0	96	10
150	0	41	4
175	0	18	2
200	0	8	1
250	0	1	0
300	0	0	0

NOTE: All concentrations in micrograms per liter

FIGURES

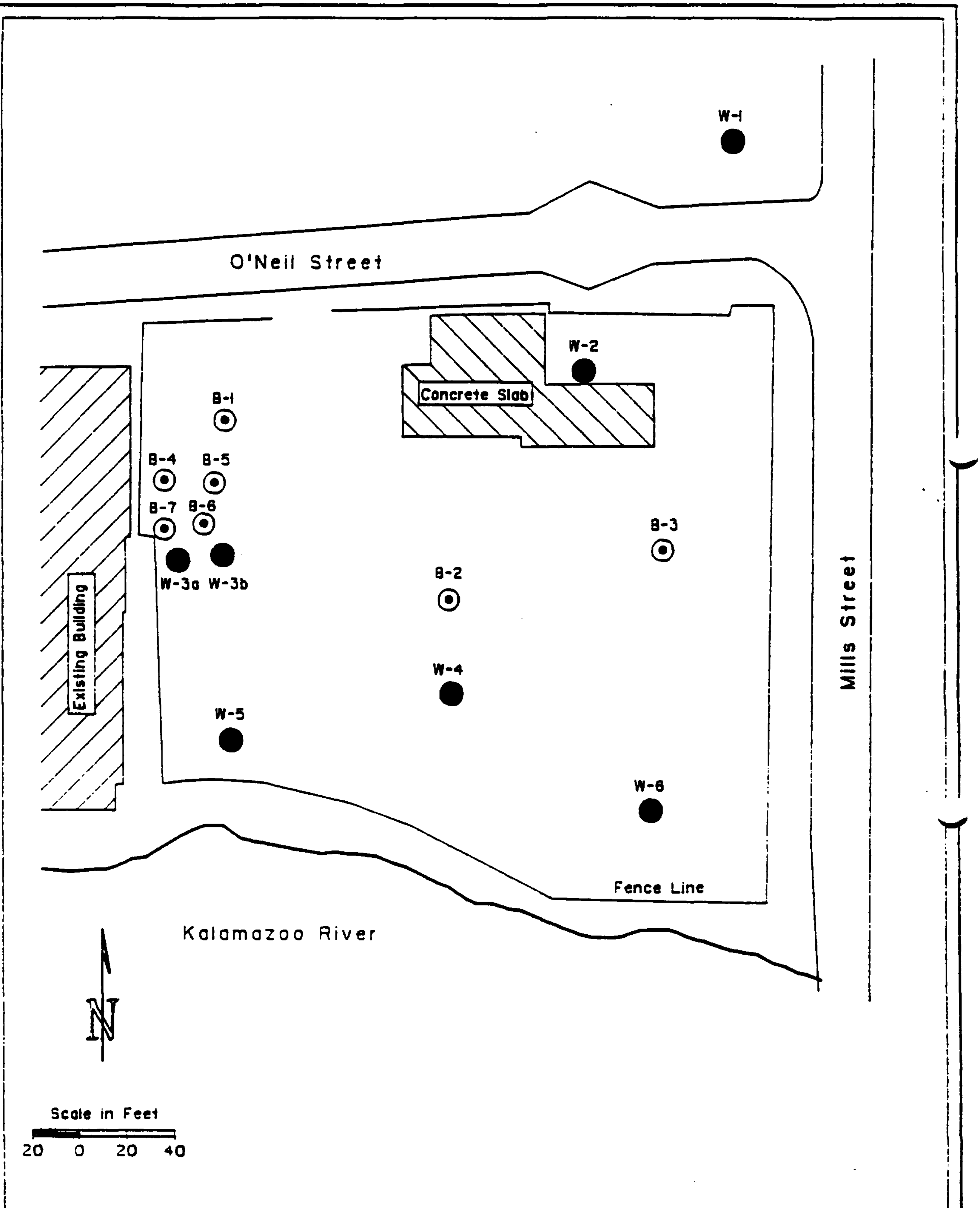


Figure 1 - Auto-Ion Site Area

Auto-Ion

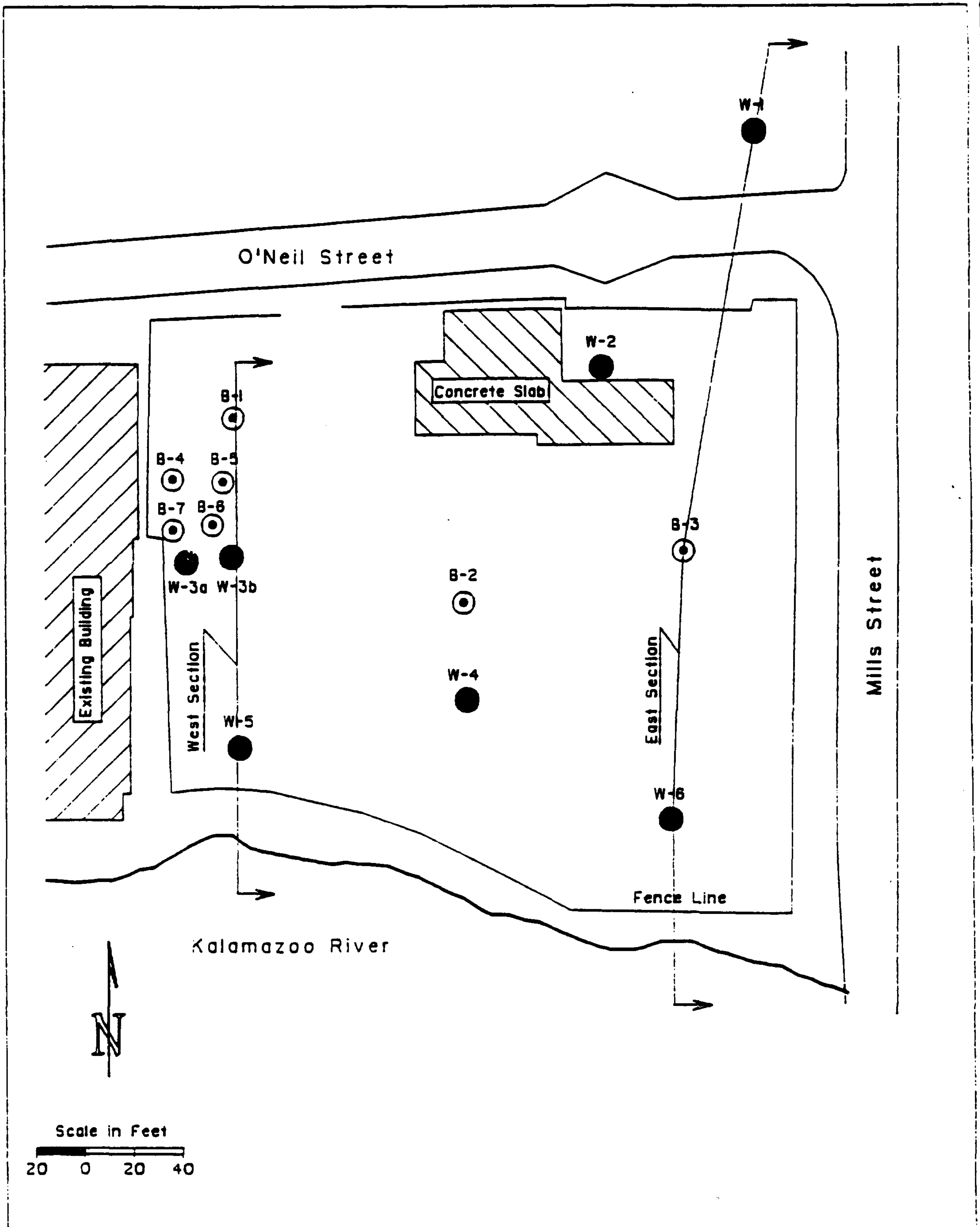


Figure 2 - Location of Cross-Sections

Auto-Ion

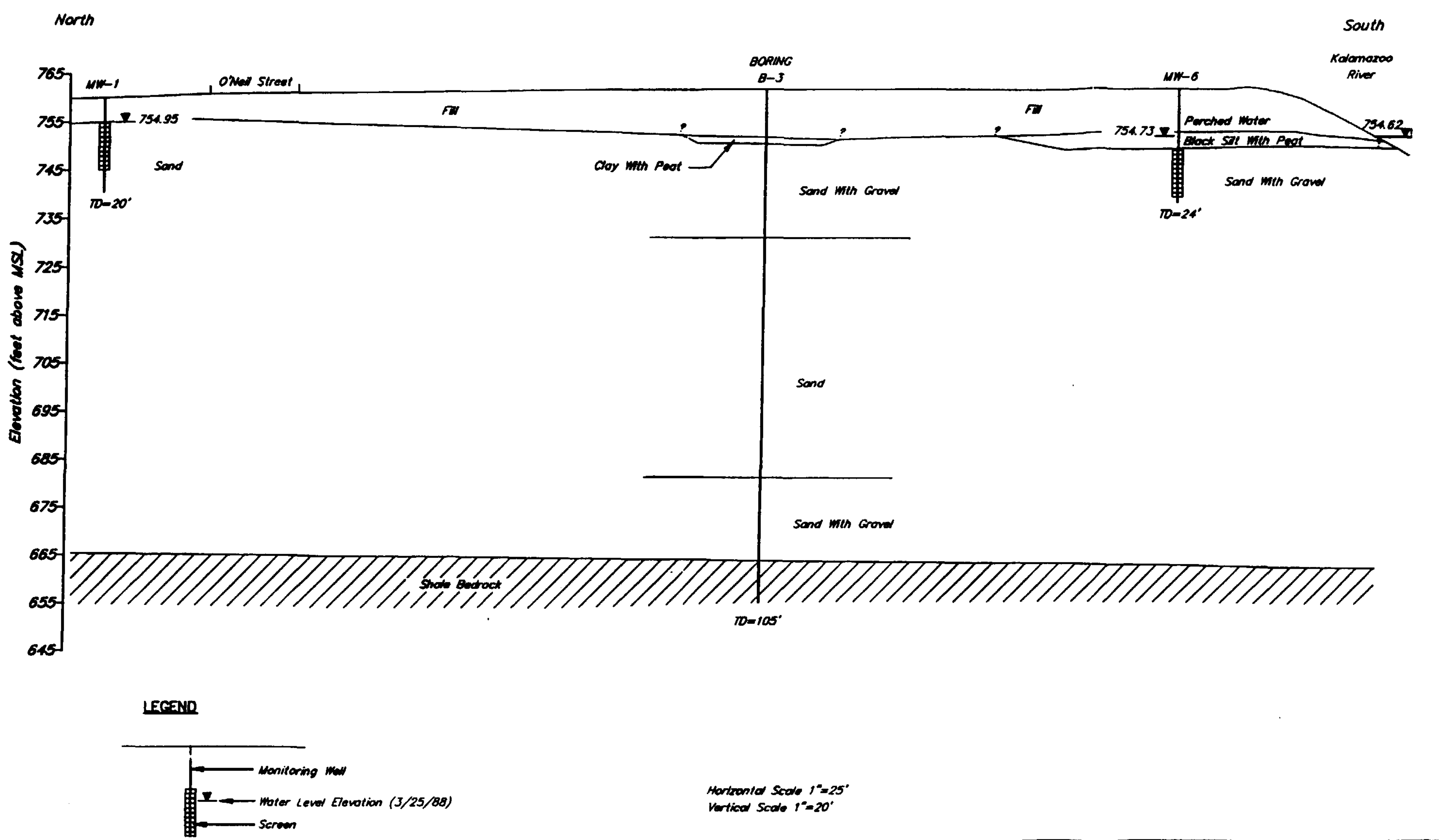
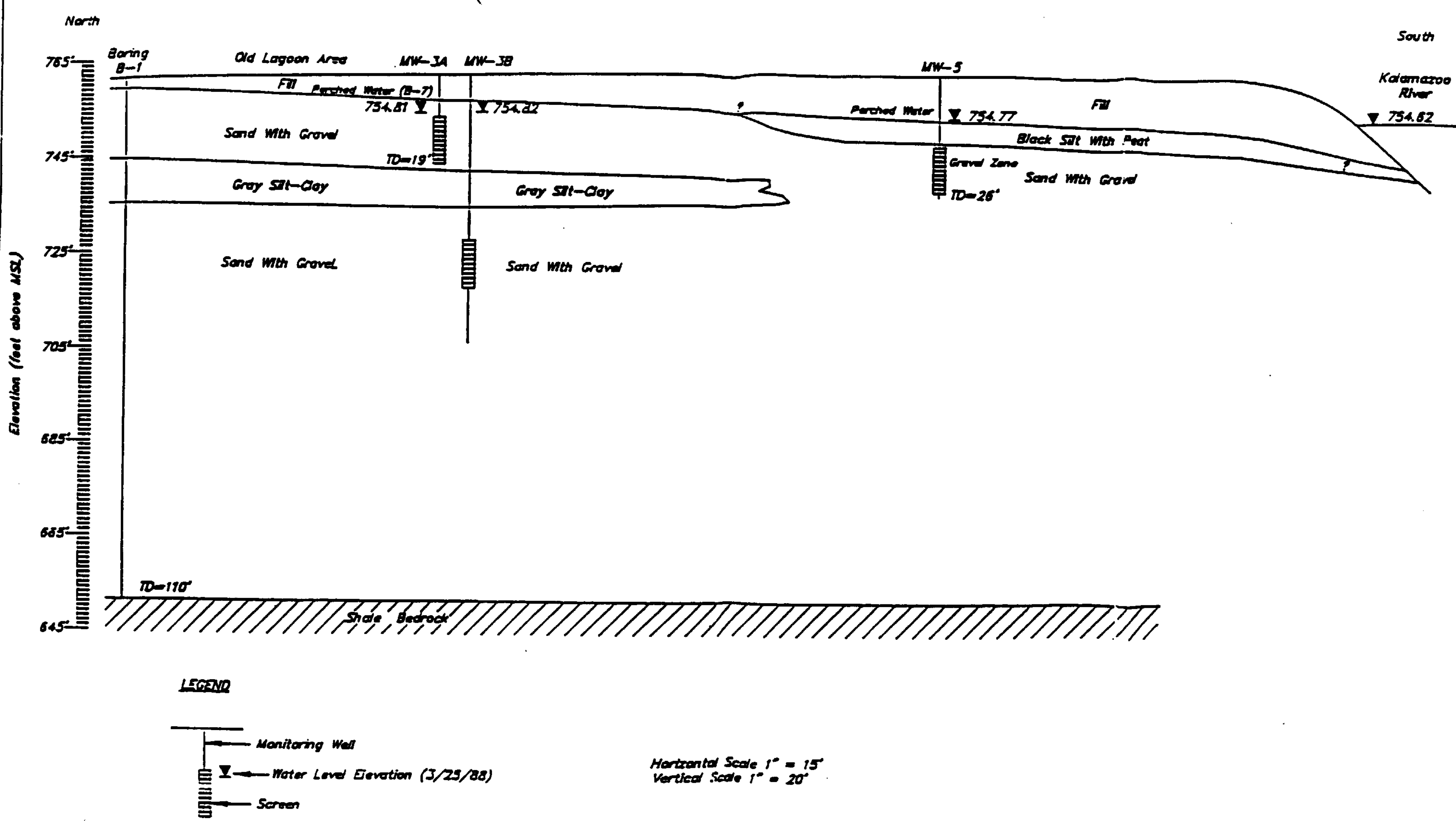


Figure 3 - Cross-Section Through Eastern Side of Site

Auto-Ion



SOURCE: EDER ASSOCIATES CONSULTING ENGINEERS
APRIL 14, 1992

Figure 4 - Cross-Section Through Western Side of Site

Auto-Ion

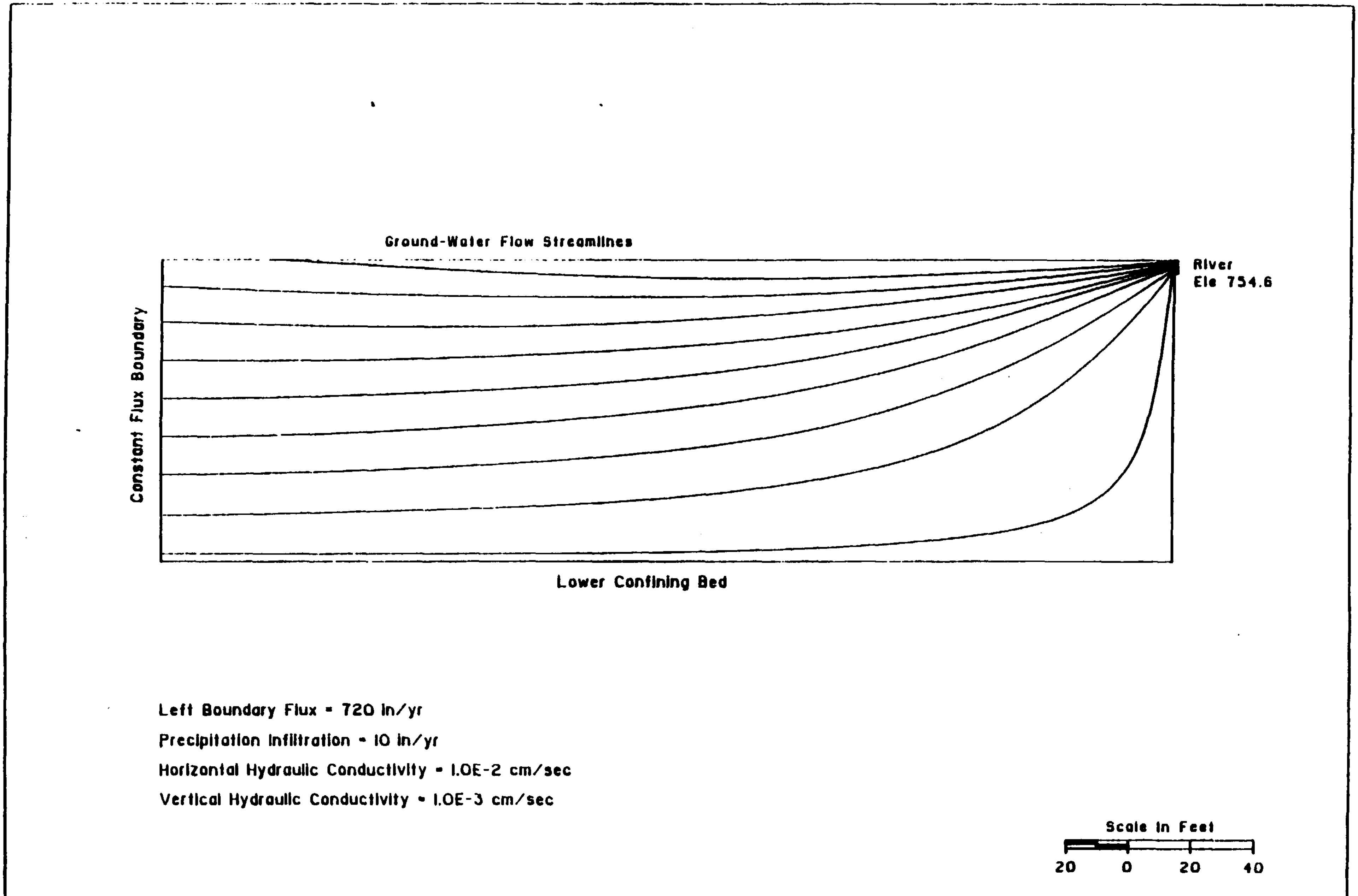


Figure 5 - Ground-Water Flow Streamlines

Auto-Ion

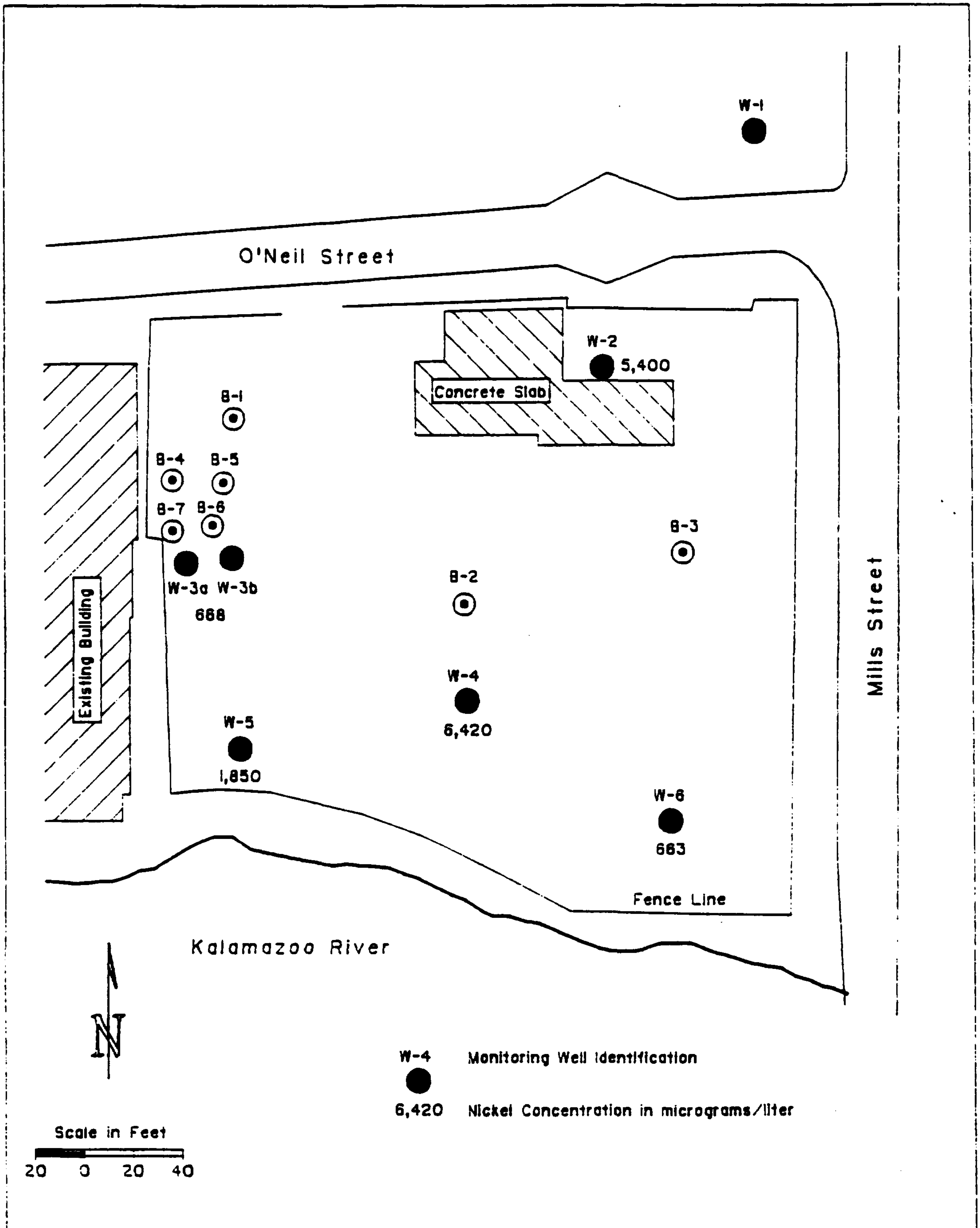


Figure 6 - Nickel Concentrations Auto-Ion Site Area

Auto-Ion

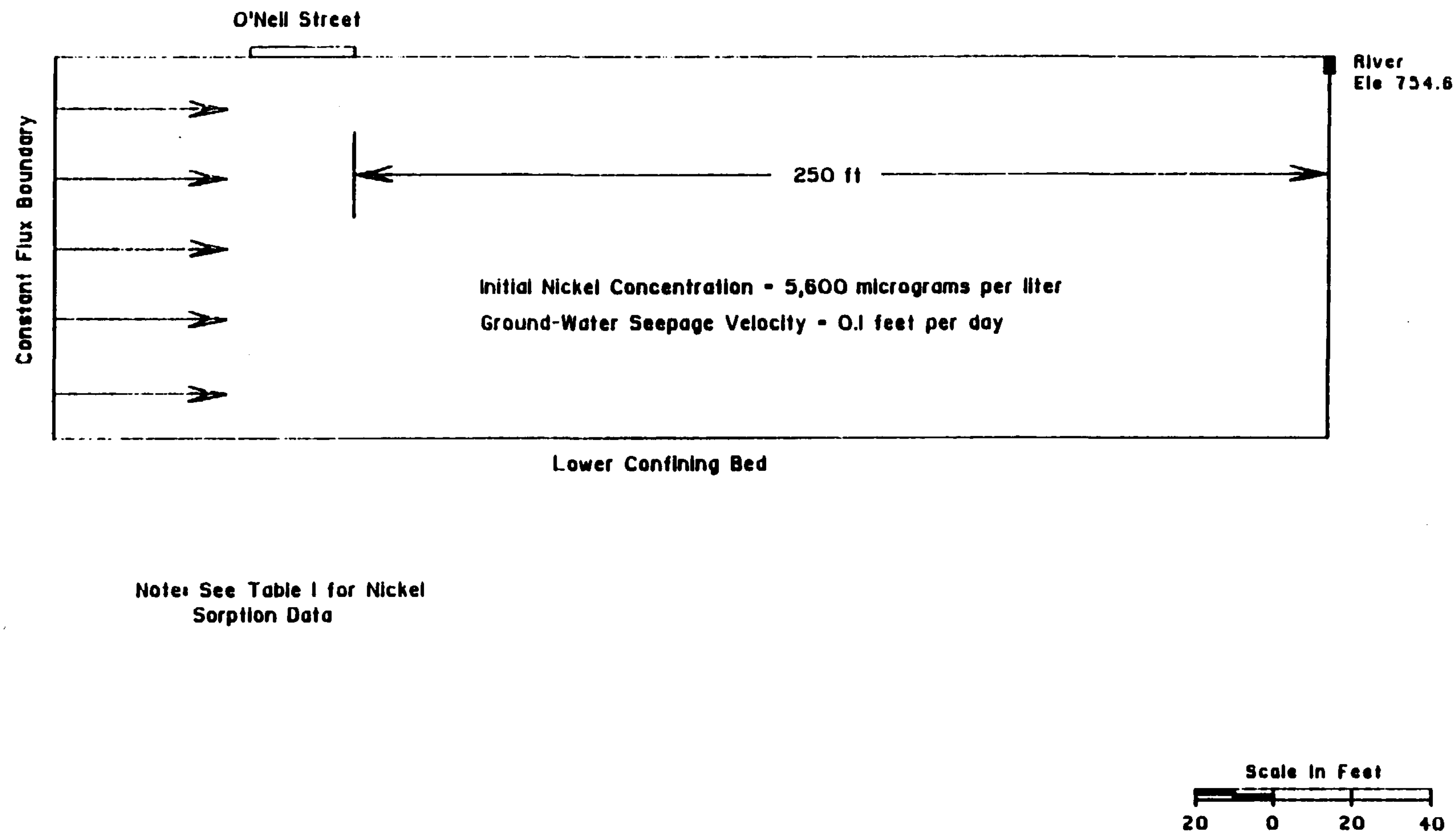


Figure 7 - POLLUTE Model Lay-Out

Auto-Ion

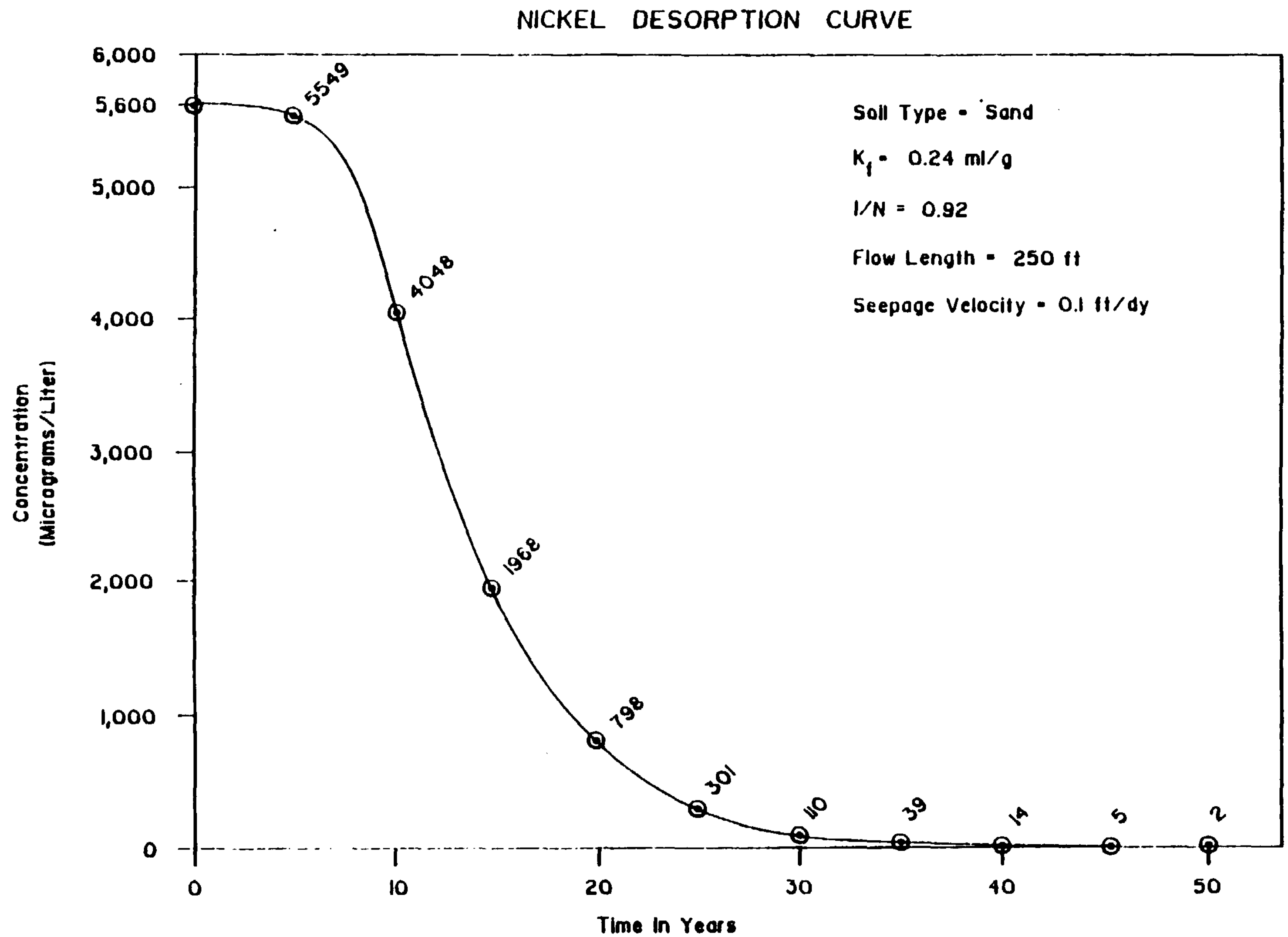


Figure 8 – Desorption by Natural Flushing in Sandy Soil Materials

Auto-Ion

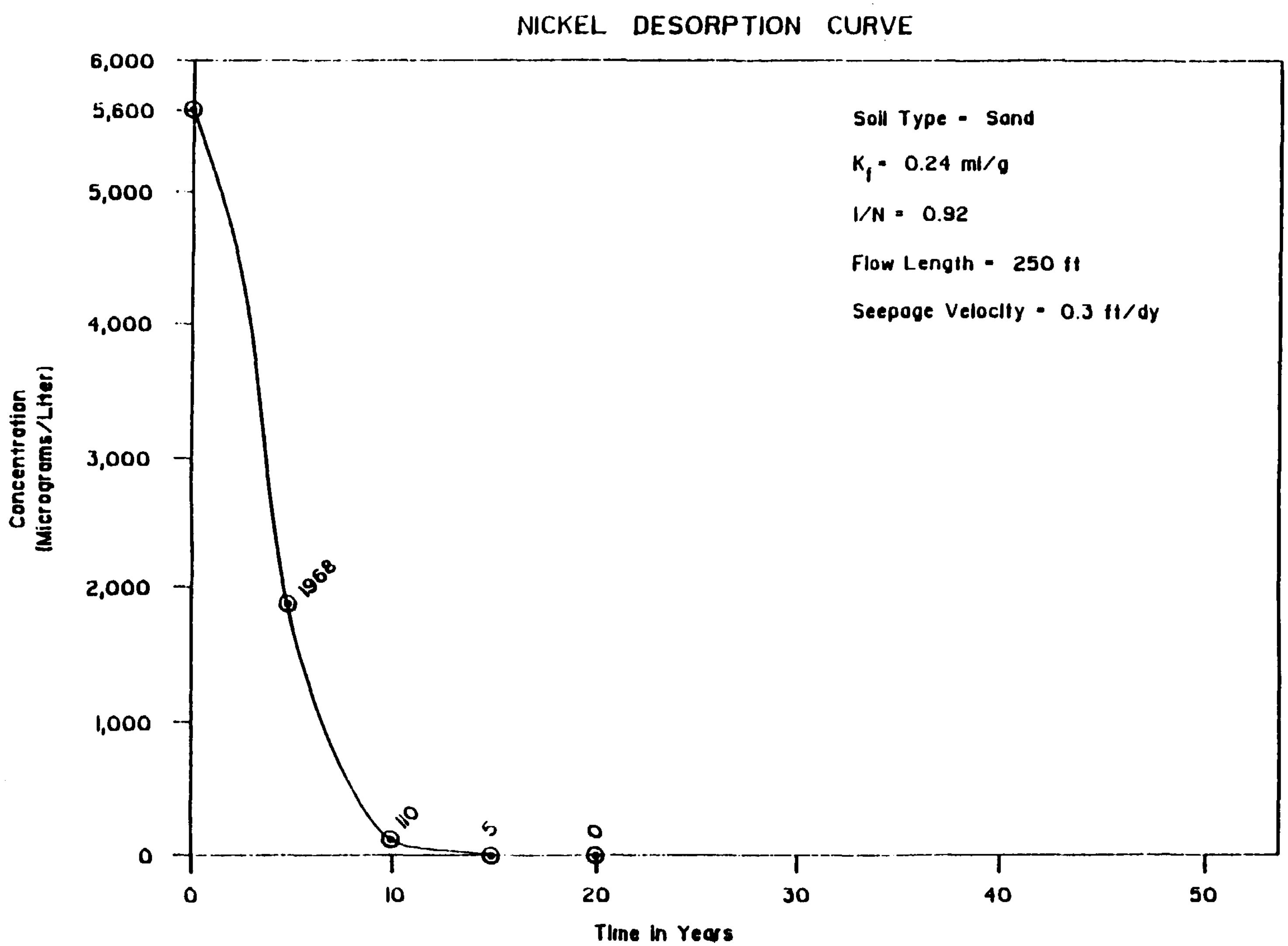


Figure 9 - Desorption by Remedial Flushing in Sandy Soil Materials

Auto-Ion

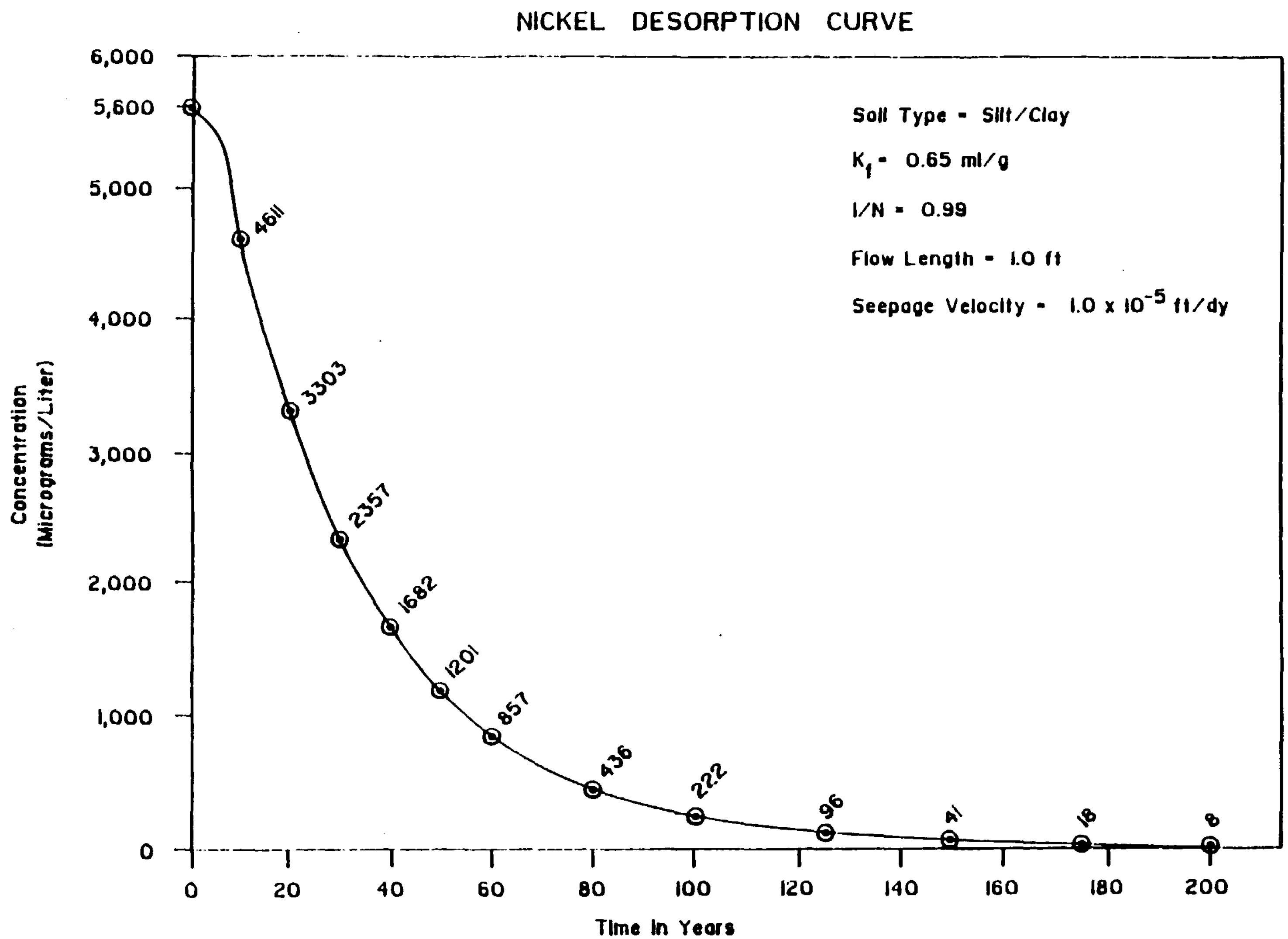


Figure 10 - Nickel Desorption in Silt/Clay Soil Materials

Auto-Ion

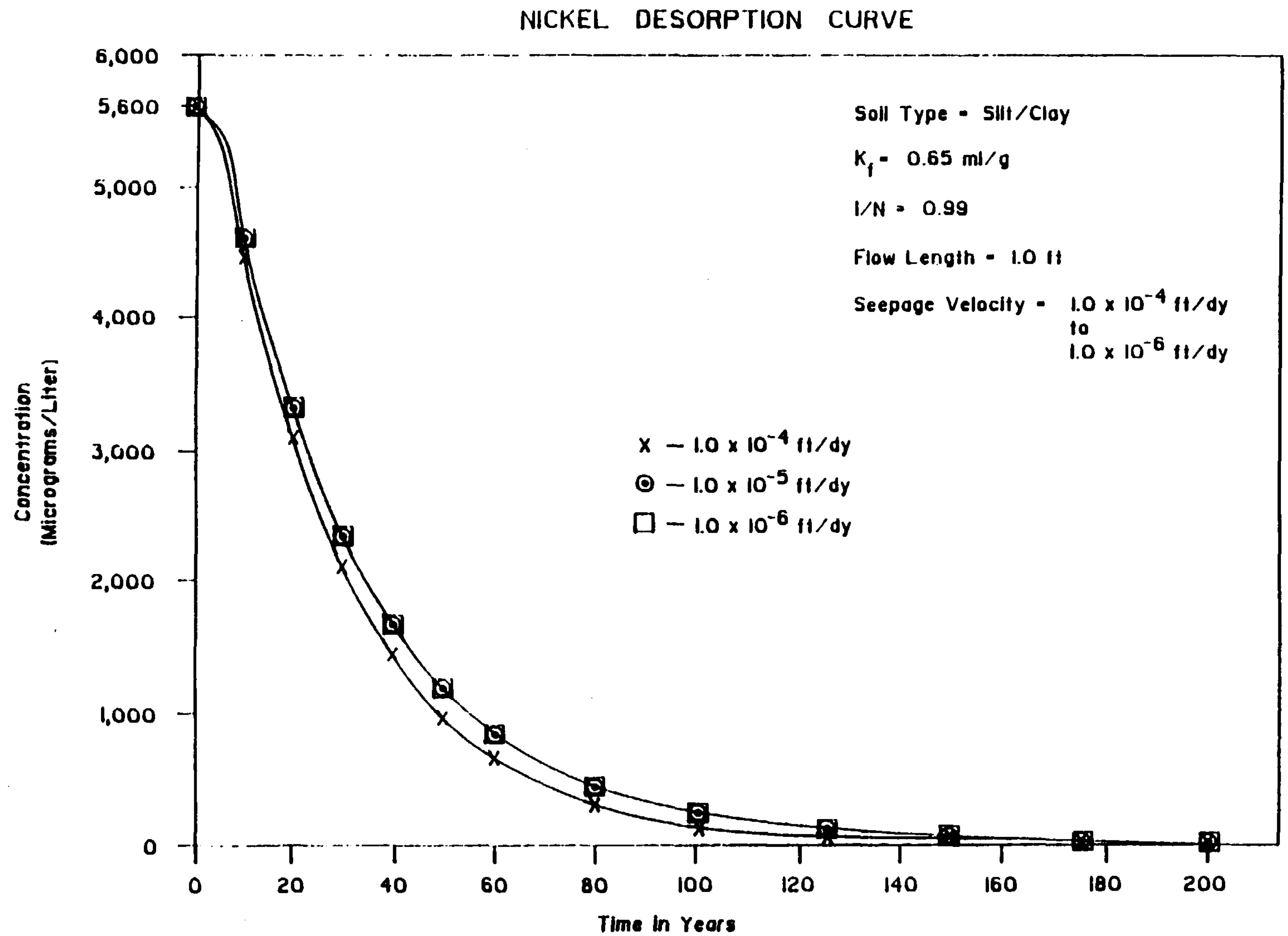


Figure II – Comparison of Nickel Desorption in Silt/Clay Soil Materials

Auto-Ion

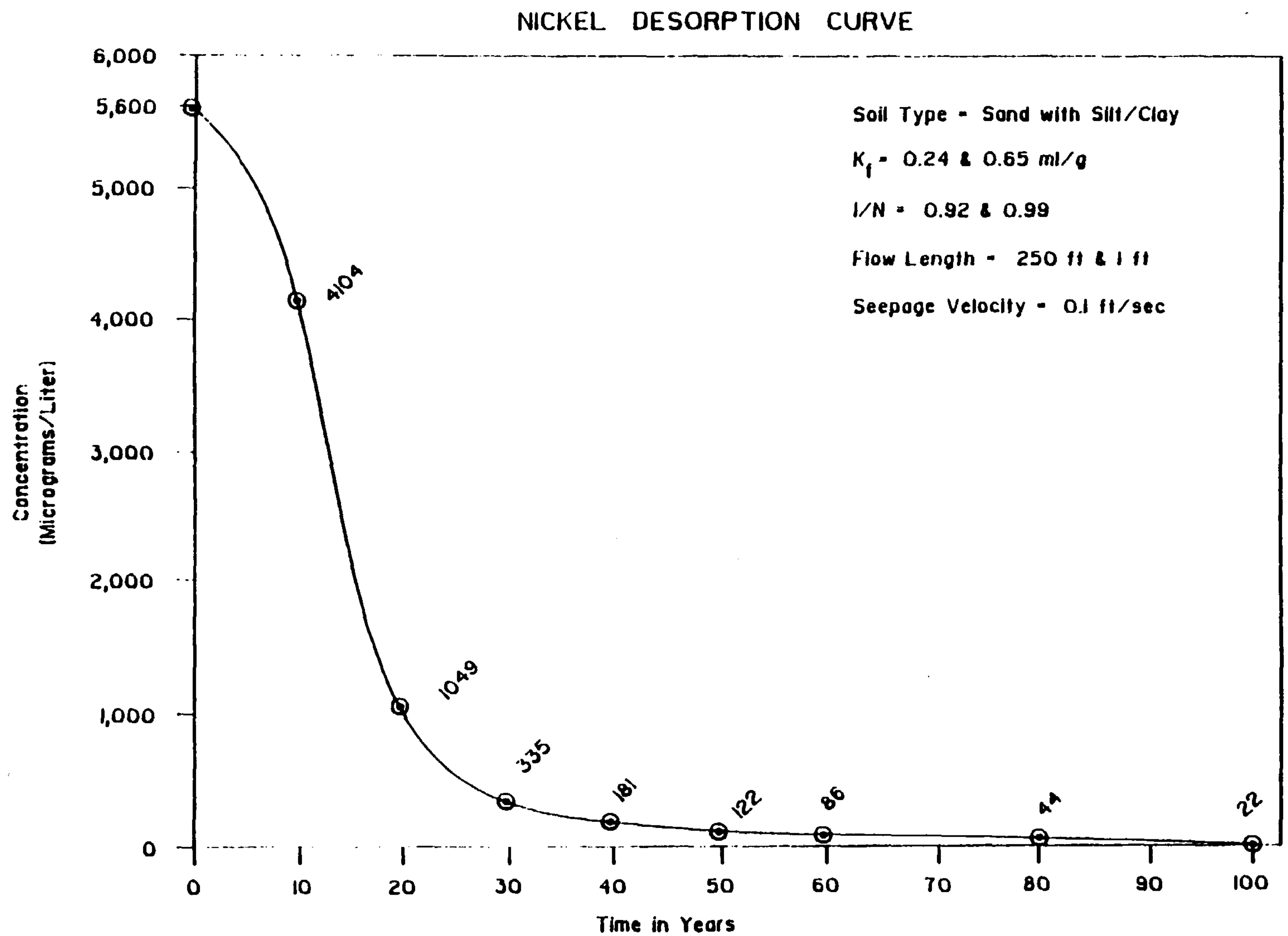


Figure 12 – Desorption by Natural Flushing in Sandy Soil with Silt/Clay

Auto-Ion

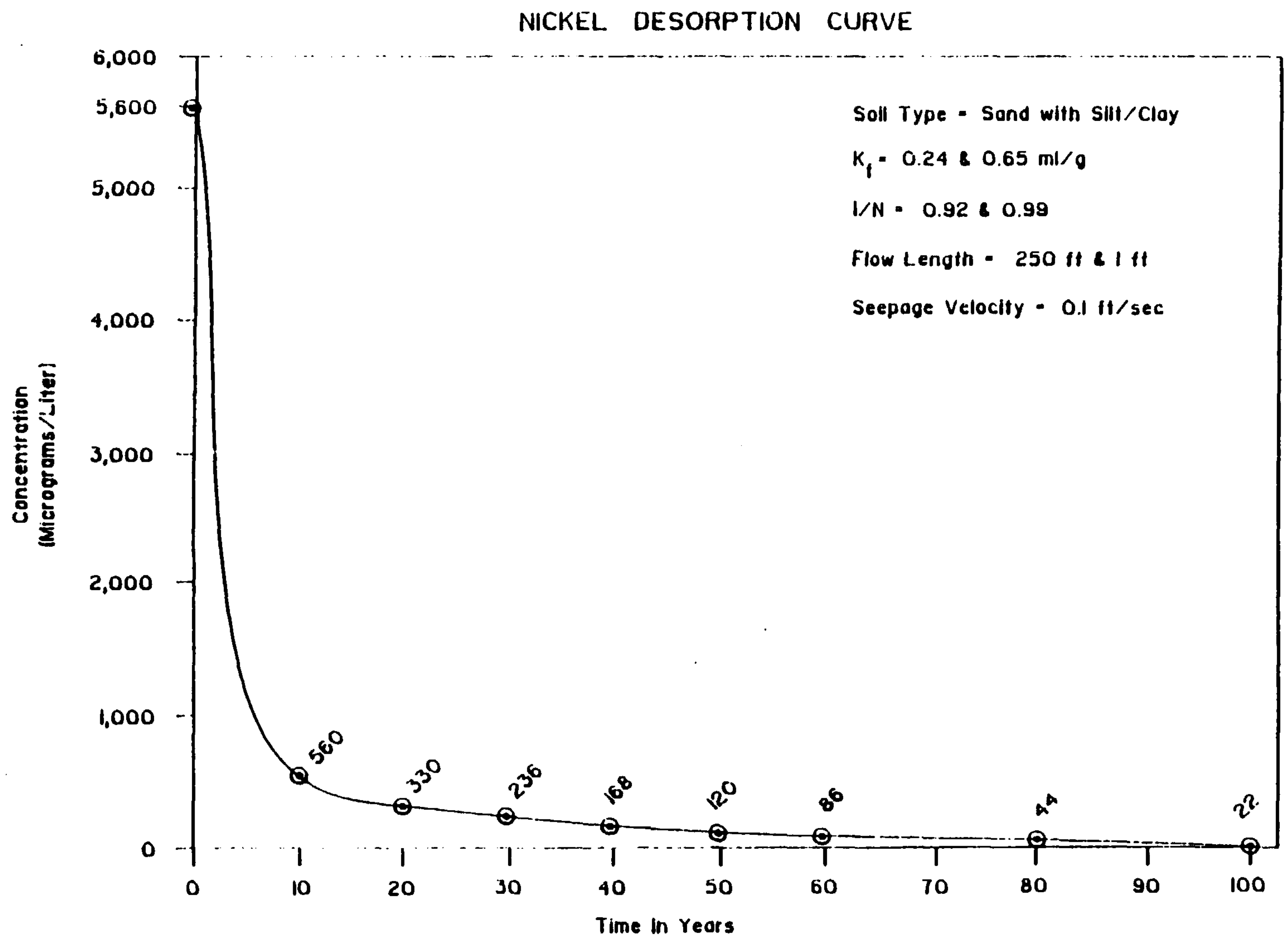


Figure 13 - Desorption by Remedial Flushing in Sandy Soil with ('t/Clay

Auto-Ion

APPENDIX G

CITY OF KALAMAZOO WWTP DISCHARGE LIMITATIONS

Discharge Limitations

Discharges to the Kalamazoo Water Reclamation Plant are controlled by the following limitations:

Pollutant	Daily Maximum Concentration Limit (mg/L)
Cadmium, T	0.040
Chromium, T	4.67
Copper, T	2.23
Lead, T	0.110
Nickel, T	1.59
Zinc, T	5.30
Cyanide, T	0.250
Oils & Greases	100
pH	6.2 - 9.8 S.U.

Prohibited Discharges - condensed from the General Pretreatment Regulations and the Kalamazoo City Code of Ordinances.

1. PCBs - no discharge allowed.
2. Mercury - no discharge allowed.
3. Pollutants which cause a fire or explosion hazard including, but not limited to, wastestreams with a closed cup flash point of less than 140 degrees Fahrenheit or 60 degrees Centigrade.
4. Solid or viscous pollutants in amounts which will cause obstruction in flow.
5. Any pollutant, including oxygen demanding pollutants (BOD, etc.) which will cause interference with wastewater treatment or which will pass through untreated.
6. Heat in amounts which will inhibit biological activity, but in no case heat in such quantities th the temperature at the plant exceeds 40° C (104° F).
7. Pollutants which result in the presence of toxic gases, vapors, or fumes in a quantity that may cause worker health and safety problems for sewer workers or the general public.
8. Any trucked or hauled pollutants except at the designated discharge point at the Kalamazoo Water Reclamation Plant.
9. Radioactive wastes or isotopes, unless their disposal via wastewater is authorized by federal, state, and local regulations, and then only when discharge into the wastewater system does not cause damage or a hazard to the system, persons operating the system, or the general public.
10. Wastewater discharged at a rate which upsets or interferes with the treatment process or causes a hydraulic surge.
11. Storm water, uncontaminated groundwater, unpolluted non-contact cooling water.

In addition to these limitations, certain industrial discharges are subject to Categorical Pretreatment Standards.

APPENDIX H

CITY OF KALAMAZOO SEWER ORDINANCE

Chapter 28

SEWERS*

Art. I. In General, §§ 28-1—28-23
Art. II. Service Charges, §§ 28-24—28-32

ARTICLE I. IN GENERAL

Sec. 28-1. Definitions.

When used in this chapter, or rules and regulations adopted pursuant to this chapter, the following words, terms and phrases shall have the meaning specified herein:

Biochemical oxygen demand or *BOD* means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five (5) days at twenty (20) degrees Celsius expressed in terms of weight and concentration as milligrams per liter.

Capital charges shall mean those amounts paid by each premise connected to the treatment works to pay the debt service requirements and capital expenditures to enlarge or improve the waste water facilities.

Chapter means Chapter 28 of the Kalamazoo City Code.

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*Cross references—Ord. No. 1190, § 1, enacted March 3, 1980, amended Ch. 28 to read as herein set out. Prior to amendment, Ch. 28 pertained to the same subject and consisted of Arts. I and II, §§ 28-1—28-18, 28-24—28-27, 28-29—28-32. Said former Ch. 28 derived from P.S. Code, §§ 302.1—302.15, 302.21—302.23, 302.31, 302.34, 302.34A, 302.35, 302.36, 302.38, 302.39, 302.310—302.312 and Ord. No. 1074, § 1, enacted Dec. 29, 1975; Ord. No. 1154, § 1, adopted April 2, 1979.

Cross references—County sewage disposal ordinance adopted by city, § 1-6(b)(8); department of public utilities, § 2-313 et seq.; buildings and building regulations, Ch. 9; plumbing code, § 9-78 et seq.; plugging of sewer lines when building moved or wrecked, § 9-254; housing code, Ch. 17; special assessments for public improvements, Ch. 32; assessment line for sewer improvements, § 32-9; connection of swimming pool drain line to city sewer system, § 34-7; water, Ch. 38.

Chemical oxygen demand or *COD* means the quantity of oxygen utilized in the chemical oxidation of organic matter, expressed in terms of milligrams per liter.

Commercial user means any user of the wastewater system who does not meet the definition (below) of *industrial user* but whose primary use of the user's property is not residential. As an exception to the foregoing definition of *commercial user*, if the director determines that the activities or wastewater of the user are characteristic of an industrial rather than a commercial user, the director may classify the user as industrial.

Compatible pollutant means those pollutants which the wastewater system is or may be designed to reduce or remove from wastewater in accordance with its NPDES permit.

Cooling water means the water discharged from any use such as air-conditioning, refrigeration or other cooling to which the only pollutant added is heat.

Direct water cooling means the use of water as a refrigerant or as a primary heat transfer medium.

Director means director or acting director of the department of public utilities of the city or his designee or authorized representative.

FWPCA means the Federal Water Pollution Control Act, as amended, or as that act may be hereafter amended.

Garbage means solid waste from the domestic or commercial preparation, cooking, dispensing, storage, handling or sale of food.

Indirect water cooling means the use of water to extract heat from a refrigerant or as a secondary heat transfer medium.

Industrial or commercial wastes means the wastewater from the place of the user's business, trade or profession.

Industrial user shall mean any user of the wastewater system which:

(a) Is identified in the *Standard Industrial Classification Manual*, 1972, Office of Management and Budget, as amended and supplemented under one (1) of the following divisions:

Division A: Agriculture, Forestry and Fishing.

Division B: Mining.

Division C: Construction.

Division D: Manufacturing.

Division E: Transportation; Communications; Electric, Gas and Sanitary Services.

Division F: Wholesale Trade.

Division G: Retail Trade.

Division I: Services; or

(b) Any user of the wastewater system which discharges wastewater to the wastewater system which wastewater contains toxic pollutants or poisonous solids, liquids or gases in sufficient quantity, either singly or by interaction with other wastes, to contaminate the sludge of any municipal systems, or to injure or to interfere with any sewage treatment process, or which constitutes a hazard to humans or animals, creates a public nuisance, or creates any hazard in or has an adverse effect on the waters receiving any discharge from the treatment works; or

(c) Any user of the wastewater system which discharges wastewater containing pollutants which may interfere with the treatment process, may be toxic or incompatible, may interfere with the processing or disposal of the sludge, or m[illegible] have an adverse effect on the receiving stream.

(d) As an exception to (a) above, if the director determines that the activities and wastewater of the user are characteristic of a commercial rather than an industrial user, the director may classify the user as commercial, which classification would continue only as long as the user's activities and wastewater remain commercial rather than industrial.

Infiltration shall mean water other than wastewater that enters a sewer system (including building drains and building sewers) from the ground through such means as defective pipes, defective pipe joints, defective connections or defective manholes. *Infiltration* does not include and is distinguished from *inflow*.

Infiltration inflow (I/I) shall mean the total quantity of water from both infiltration and inflow without distinguishing the source.

Inflow shall mean water other than wastewater that enters a sewer system (including building drains and building sewers) from sources such as roof leaders, cellar drains, yard drains, area drains, foundation drains, drains from springs and swampy areas, manhole covers, cross-connections between storm sewers and sanitary sewers, catch basins, cooling towers, stormwaters, surface runoff, street wash waters, or drainage. Inflow does not include, and is distinguished from, infiltration.

Major contributory industry means an industrial user of the wastewater system that:

(a) Has a flow of fifty thousand (50,000) gallons or more per average workday, or

(b) Has a flow greater than five (5) per cent of the flow carried by the municipal system receiving the waste; or

(c) Has in its waste a toxic pollutant in toxic amounts as defined in standards issued under Section 307 of the FWPCA, or by the director; or

(d) Is found by the director or State of Michigan, in connection with the NPDES permit issued to the city, to have significant impact, either singly or in combination with other contributing industries, on the wastewater system or upon the quality of effluent from the wastewater system.

Mg/l means milligrams per liter.

Natural outlet means any outlet into a watercourse, pond, ditch, lake or body of surface or groundwater.

Nonindustrial user shall mean any user of the wastewater system not classified as an industrial user.

NPDES or *National Pollutant Discharge Elimination System* means the program for issuing, conditioning and denying permits for the discharge of pollutants from point sources into the navigable waters, territorial seas and contiguous zones of the United States pursuant to Section 402 of the FWPCA.

pH means the logarithm of the reciprocal of the weight of hydrogen ions in grams per liter of solution.

Pollutant means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, residential and agricultural waste.

Pollution means the man-made or man-induced alteration of the chemical, physical, biological or radiological integrity of water.

Pretreatment means application of physical, chemical and/or biological processes to reduce the amount of pollutants in or alteration of the nature of the pollutant properties in wastewater prior to discharging such wastewater into the wastewater system.

Pretreatment standards means all applicable rules and regulations implementing Section 307 of the FWPCA, as well as any nonconflicting state or local standards which may require more restrictive treatment of wastewater under the circumstances described in Section 307.

Properly shredded garbage means garbage that has been shredded to such a degree that no particle shall be larger than one-half (1/2) inch or one and twenty-seven hundredths (1.27) centimeters in any dimension, and all particles can be carried freely in the wastewater under the flow conditions normally prevailing in the wastewater system.

Sanitary sewer means a pipe or system of pipes that convey wastewaters from residences, commercial buildings, industrial plants, institutions or other structures as a part of the wastewater collection system.

Sludge shall mean the accumulated solids separated from liquids during the treatment of wastewaters.

Storm drain or *storm sewer* means any drain or sewer intended expressly for the conveyance of stormwater and surface water, street wash, or drainage or other unpolluted water.

Suspended solids means the total suspended matter that floats on the surface of, or is suspended in, wastewater and that is removable by laboratory filtering.

User means any person who discharges or causes or permits the discharge of wastewater into the wastewater system and/or the owner or occupant of any property from which said discharge is made.

Wastewater means water, or any liquid, whether or not containing pollutants, which is discharged or permitted to be discharged into the wastewater system.

Wastewater system means the complete wastewater collection, treatment and disposal system of the city including all works, instrumentalities or properties used or useful therein.

Watercourse means any natural channel or body of water in which a flow of water occurs either continuously or intermittently. (Ord. No. 1190, § 1, 3-3-80; Ord. No. 1268, § 19, 9-7-82; Ord. No. 1373, § 1, 3-10-86; Ord. No. 1495, §§ 1, 2, 5-14-90)

Sec. 28-2. System to be operated on rate basis.

From and after April 1, 1980, the wastewater system shall be operated and maintained on the rate basis as authorized by law and provided for in this chapter. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-3. Management of system.

The wastewater system of the city shall be and remain under the management, supervision and control of the city manager, who may employ or designate such person or persons in such capacity or capacities as he deems advisable to carry out the efficient management and operation of the system. The director, subject to the approval of the city manager, may make such rules, orders or regulations as he deems advisable and necessary to assure the efficient management and operation of the system and to provide equitable charges for the services thereof subject, however, to the rights, powers and duties in respect thereto which are reserved by law to the city commission. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-4. System records and budget.

(a) The city manager shall cause to be maintained and kept proper books of records and account in which shall be made full and correct entries of all transactions relating to the wastewater system. Not later than three (3) months after the close of the fiscal year, the city manager shall cause to be prepared a statement, in reasonable detail, showing the cash income and disbursements of the system at the beginning and close of the operating year and such other information as may be necessary to enable any taxpayer of the city or user of the service furnished to be fully informed as to all matters pertaining to the financial operation of the system during such year.

(b) A budget, showing in detail the estimated costs of administration, operation, and maintenance of the wastewater system for the next ensuing fiscal year, including billing, accounting, postage and related costs, and including an amount equal to the bond principal and interest due to be paid in said year, shall be prepared by the city manager at the same time as he is required by the Charter to prepare the annual city budget, which budget shall be subject to the approval of the city commission. The amounts transferred into the operation and maintenance fund during each year shall not exceed the amount set forth in such budget unless approved by vote of the city commission. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-5. Use of public sewers required.

(a) It shall be the duty of the owner of any inhabited building, or of any building discharging pollutants into water, situated on land abutting or fronting on any street or alley in which a sanitary sewer has been laid, or in which a sanitary sewer shall hereafter be built, to connect such building, at his own expense, with the sewer adjacent thereto, within thirty (30) days after notice.

(b) It shall be unlawful for any person to place, deposit or permit to be deposited in any unsanitary manner on public or private property within the city or in any area under the jurisdiction of said city any human or animal excrement, industrial waste, garbage or objectionable waste. This paragraph shall not apply to the making or use of compost or fertilizer by said person on his or her own property if done in compliance with any and all laws, ordinances and regulations as part of a lawful business or domestic agricultural activity which poses no substantial threat to public health, safety or welfare and is not a common-law nuisance.

(c) It shall be unlawful to discharge to any natural outle within the City of Kalamazoo, or in any area under th jurisdiction of said city, any waste water or other pollute waters except where suitable treatment has been provided i accordance with all applicable rules and regulations o local, state and federal regulatory agencies.

(d) Except for facilities approved by the Kalamazoo Count Health Department in accordance with the county publi health code, sewage disposal regulations, it shall b unlawful to construct or maintain any privy, privy vaul septic tank, cesspool, or other facility intended or used fo the disposal of waste water within the City of Kalamazo (Ord. No. 1190, § 1, 3-3-80)

State law reference—Provisions similar to subsection (a), abov MCLA, §§ 333.12751—333.12758.

Sec. 28-6. Connection charges.

(a) The city manager is hereby authorized, with the consent the city commission, to determine and establish a schedule construction charges for the various sizes and types of sanita sewer connections for each calendar year. Each schedule sha become effective when approved by motion duly adopted by th city commission. Such schedule of charges shall be based on th following, as applicable:

(1) Recovery of all costs normally incurred for this type construction.

(2) The size and length of pipe to be used for connection.

(3) Extra costs of construction during winter months.

(4) Repair or replacement of pavement and sidewalk.

(5) Exceptional surface repairs, including landscaping.

(b) The director of the department of public utilities may tablish advance deposits for sanitary sewer connection constru tion charges for each calendar year.

(c) Advance deposits toward sanitary sewer connection constr tion charges established under this section shall be made bef construction. Any balance owed shall be due within thirty (

days after billing. Interest at the rate of one (1) per cent per month shall be charged upon any delinquent unpaid balance. If such unpaid balance, with interest, is not paid within six (6) months, that fact shall be reported to the city commission for the establishment for a lien against the real estate. (Ord. No. 1190, § 1, 3-3-80; Ord. No. 1334, § 1, 9-24-84)

Sec. 28-7. Permit to connect, generally.

(a) Permits for connections with sanitary sewers shall be issued by the department of public utilities. All permits and special assessment records and payments related thereto shall be kept by the city treasurer. No such permit shall be issued until all assessments due and all advance deposits established have been paid and until the director of the department of public utilities has determined that there is capacity available for the waste water to be discharged in all downstream sewers, lift stations, force mains and the waste water treatment plant, including capacity for compatible waste.

(b) The director of the department of public utilities may require from any proposed user or from any existing user who is altering the composition of the waste water, a compatibility study to demonstrate to the satisfaction of the director of the department of public utilities that the waste water to be discharged is compatible with the existing waste water system, will not affect any requirements imposed upon the city, and will not adversely affect the waste water system. (Ord. No. 1190, § 1, 3-3-80; Ord. No. 1334, § 2, 9-24-84)

Sec. 28-8. Unauthorized connections.

No person not duly authorized shall make any connection with any of the sanitary sewers, or tap any main, lateral or private connecting sanitary sewer. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-9. Limitations on waste water discharging.

(a) If any waters or wastes are discharged or are proposed to be discharged to the public sewers, which waters contain the substances or possess the characteristics enumerated in section 28-10, and which in the judgment of the director may deleteriously affect the waste water system or carry through the system untreated any pollutant regulated by the NPDES permit issued to the city; or constitute a hazard to human or animal life or to any watercourse receiving the treated effluent or the waste water system; or violate any pretreatment standards hereinafter established; or cause the waste water system to violate its NPDES permit or other applicable receiving water standard, the director may:

(1) Reject the wastes,

(2) Require pretreatment to an acceptable condition for discharge to the public sewers,

(3) Require control over the quantities and rates of discharge, and/or

(4) Require payment to cover added cost of handling and treating the wastes not covered by existing taxes or sewer use charges under the provisions of sections 28-25.

(b) If the director permits or requires the pretreatment or equalization of waste flows, the design and installation of the plants and equipment shall be subject to the review and approval of the State of Michigan, Department of Natural Resources, in accordance with the laws of the State of Michigan and regulations promulgated thereunder. The property owner shall not commence construction of such facility until he has obtained such approvals in writing from the director and appropriate state agencies.

(c) Each contributing industrial user as defined in section 28-1 of the treatment facilities shall pretreat any pollutant in its waste water which may interfere with, pass through untreated, reduce the utility of municipal sludge, or otherwise be incompatible with the treatment works. Pretreatment of such pollutants shall be in accordance with Section 307 of Public Law 92-500, 40 CFR 403, and as determined by the director. All owner(s) of any source to which pretreatment standards are applicable shall be in compliance with such standards within the shortest reasonable time, but not later than the date of compliance required by 40 CFR 403 or the date established by the director, whichever first occurs. All owner(s) of any source to which pretreatment standards are applicable shall submit to the director semi-annual notices regarding specific actions taken to comply with such standards. Such notices shall be submitted on the first day of the months of April and October.

(d) If any contributing industrial user proposes to pretreat its wastes, the design and installation of the plants and equipment shall be subject to the review and approval of the director. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-10. Prohibited discharges.

No person shall convey, deposit or cause or allow to be discharged, conveyed or deposited into the waste water system any pollutant other than a compatible pollutant which the system expressly agrees to accept from a user, or any waste water containing any of the following:

(a) *Oils and grease.* Fats, wax, grease or oils in excess of one hundred (100) mg/l or containing substances which may solidify or become viscous at temperatures between zero degrees and sixty-five (65) degrees centigrade at the point of discharge into the waste water system, or concentrations or amounts of oil or grease from industrial facilities violating pretreatment standards.

(b) *Explosive mixtures.* Liquids, solids or gases which by reason of their nature or quantity are, or may be, sufficient either alone or by interaction with other substances to cause fire or explosion. Such prohibited materials include but are not limited to gasoline, kerosene, naptha, benzene, toluene, xylene, ethers, alcohols, ketones, aldehydes, peroxides, chlorates, perchlorates, bromates and carbides.

(c) *Noxious materials.* Solids, liquids or gases from processes employed in the user's business, trade or profession which, either singly or by interaction with other wastes, are capable of creating a public nuisance or hazard to life, or are or may be sufficient to prevent entry into a sewer for maintenance or repair.

(d) *Improperly shredded garbage.* Garbage which is not properly shredded garbage as defined in this chapter.

(e) *Radioactive wastes.* Radioactive wastes or isotopes, unless their disposal via waste water is authorized by federal, state and local regulations, and then only when discharge into the waste water system does not cause damage or a hazard to the system, the persons operating the system or the general public.

(f) *Excessive levels of toxic substances.* Any toxic substances in amounts which cannot be handled by the system or which exceed standards promulgated by the United States Environmental Protection Agency pursuant to Section 307(b) of the FWPCA, or toxic substances included in any regulations of the Michigan Department of Natural Resources which identify and prohibit discharge of toxic substances into the water of the state.

(g) *Untreatable pollutants.* Any pollutant which deleteriously affects the waste water system or process, or any pollutant which is regulated by the NPDES permit issued to the city and which will pass untreated or unaffected by the treatment system.

(h) *Discoloring pollutants.* Any pollutant which imparts a color to the waste water in the waste water system, which color cannot be removed by the system's treatment process or which is prohibited by the NPDES.

(i) *Corrosive wastes.* Any waste water having a pH lower than 6.2 or higher than 9.8, measured at the point of entry to the waste water system, or having any other corrosive property capable of causing damage to any equipment or portion of the waste water system or injury to the system's personnel.

(j) *Solids.* Solids or viscous substances in quantities or of such size capable of causing obstruction to the flow of sewers, or other interference with the proper operation of the waste water system such as, but not limited to, ashes, bones, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, whole blood, paunch manure, hair, fleshings or entrails.

(k) *Temperture.* A temperature greater than sixty-five (65) degrees centigrade (149 degrees Fahrenheit) or less than three (3.0) degrees centigrade (37.4 degrees Fahrenheit). (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-11. Water used for cooling purposes.

(a) The purpose of this section is to prevent "inflow" as hereinbefore defined and the overloading of the sewers of the city by the discharge thereinto of water used for cooling purposes.

(b) No equipment using direct or indirect water cooling may be installed in the city, unless a means of water disposal, other than discharge into the city's sanitary sewers, is provided. No person desiring to use any such equipment shall commence installing the same until there has been filed with the building official such information as in his judgment is necessary to enable him to determine whether or not such equipment meets the requirements of this section. No permit for the installation of any such equipment may be issued by the building official involving a connection to the city's storm sewers until a permit has been obtained from the director.

(c) Any authorized agent of the city may enter onto the premises of any person using water as a cooling medium for equipment, any time that the sewers connected to such equipment become overloaded and may order such equipment shut off. In the event it is not so shut off promptly, such agent of the city may shut the same off so that there cannot be any entry into the city sewers during the period the same is overloaded. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-12. Discharge into storm sewers.

(a) It shall be unlawful for any person to discharge or flow, or cause to be discharged or flowed, or permit or allow the same to be done from any premises owned or controlled by him, any water or fluid into any public storm sewer or drain or into any sewer, drain or pipe connected with or emptying into any public storm sewer, except waters naturally resulting from rainfall or the melting of snow and ice, or unpolluted cooling waters as provided for in section 28-11.

(b) No person shall connect or attach any downspout, pipe or drain, or cause the same to be connected or attached to any public storm sewer without first having obtained permission, in writing, to do so from the department of public works. Application for such permission shall be filed with the department of public works and shall state the location of the connection and the name and address of the owner and occupant of the premises to be connected and shall be accompanied by sufficient plans and specifications as to enable the public works department to determine whether the same is proposed to be done in a good and workmanlike manner and in accordance with standard practices and so as not to endanger pedestrians and others using the public streets, alleys, and places. Upon compliance with the foregoing requirements, the public works department shall issue such permit, but upon the express condition that the applicant shall not use the downspout, pipe or drain, or permit the use thereof, for any of the purposes other than those allowed and set forth in section 28-12(a). (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-13. Excessive discharge.

(a) No discharge shall exceed the peak flow rate projected by the user as a condition precedent to connection to the waste water system.

(b) No waste water shall be discharged at a rate which upsets or interferes with the treatment process or causes a hydraulic surge in the waste water system.

Sec. 28-14. Reporting violations.

(a) If, for any reason, a person discharges, or causes or permits to be discharged, any pollutant or waste water containing a pollutant into the waste water system in violation of this chapter, that person shall immediately thereafter notify the director of said discharge to enable the director to take any action necessary for the protection of the system or the prevention of any health hazard. Notification shall be given either as soon as the person has reason to know of the discharge, or immediately after the discharge, whichever is sooner.

(b) The director may require a user of sewer services to provide information needed to determine compliance with this chapter. These requirements may include:

(1) Waste waters' discharge peak rate and volume over a specified time period.

(2) Chemical analyses of waste waters.

(3) Information on raw materials processes and products affecting waste water volume and quality.

(4) Quantity and disposition of specific liquid, sludge, oil, solvent or other materials important to sewer use control.

(5) A plot plan of sewers of the user's property showing sewer and pretreatment facility location.

(6) Details of waste water pretreatment facilities.

(7) Details of systems to prevent and control the losses of materials through spills to the municipal sewer. Any industry that has materials that could spill into the sewer system shall provide for containment of the material on site. Containment capacity shall be equal to the storage capacity provided for liquids, oils or other toxic materials stored at the plant.

(8) Such other information as may be required by the city's NPDES permit.

(c) All measurements, tests and analyses of the characteristics of waters and wastes to which reference is made in this section and other sections shall be determined in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater," published by the American Public Health Association. All tests shall conform to EPA Regulation 40 CFR 136 "Guidelines Establishing Test Procedures for Analysis of Pollutants." Sampling methods, location, times, durations and frequencies are to be determined on an individual basis subject to approval by the director and other regulatory agencies. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-15. Procedures for enforcement.

(a) A violation of the provisions of this chapter shall be considered a public nuisance per se and any action authorized or permitted by law for the abatement of public nuisances may be instituted by the city in regard to such violation.

(b) Whenever the director finds that a violation of this chapter is occurring and presents an emergency which threatens immediate, serious harm to any portion of the waste water system or which threatens to or does create an immediate health hazard, the user's waste water service may be terminated by order of the director, pending further investigation and hearing under section 28-16.

(c) Whenever a person has violated any provision of this chapter, the city may take any legal action necessary to recover damages sustained by the city as a result thereof.

Such damages shall include, but are not limited to, los revenues from the federal or state government and any fine or other penalties which are the result of the aforesaic violation. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-16. Termination of service.

(a) *Authority to terminate.* The director shall have the authority to terminate waste water service to any user whc attempts to violate or violates any provision of this chapter or who in any way attempts to avoid, delay, prevent or interfere with the execution or enforcement of any provision of this chapter, or who fails to pay any charges, levied against him, her or it, whether regular or extraordinary, under this chapter, or who attempts to violate or violates or attempts to avoid, delay, prevent or interfere with the execution or enforcement of any rule or regulation promulgated by the director for compliance with or execution of this chapter, or who fails to appear at a hearing to meet a charge against him, her or it under this chapter.

(b) *Hearing procedures.*

(1) In addition to any remedies provided elsewhere in this chapter, whenever the director has reason to believe that any user has committed or is committing an offense covered by section 28-16(a), he may serve upon the user a written notice stating the nature of the alleged violation and describing the time for and the nature of required correction.

(2) If the violation is not corrected as prescribed in the aforesaid notice, the director may issue an order to the user to appear for a hearing and show cause why service should not be terminated.

(3) The aforesaid notice and order to show cause shall be served upon the user by personal service, or in lieu thereof by certified mail, return receipt requested, to the user's last known address.

(4) The hearing shall be conducted by the city manager or a hearing officer appointed by him, who shall

render a written decision determining whether the user's service shall be terminated and stating reasons therefore. Admissibility of evidence at the hearing shall be within the discretion of the manager or officer.

(5) The user shall be entitled to be represented at the hearing in person or by an attorney at his own expense and shall be entitled to examine witnesses for the city and present evidence on his own behalf. A record shall be made of the proceedings, but such record need not be verbatim.

(6) The user whose service is terminated without prior hearing may request such a hearing as described in section 28-16(b)(4) and (5) above, to permit him to show why his service should not have been terminated and should be resumed. Such requests shall be granted, but service will not be resumed unless so ordered by the city manager or hearing officer. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-17. Inspection and monitoring of users.

(a) Industrial or commercial users of the waste water system are subject to inspection of their facilities and records pertaining to raw material use at the request of the director during all reasonable business hours, and in an emergency at any time. Said inspections may include, but are not limited to, monitoring of these users' operations. The city recognizes proper identification is necessary for access to the facilities and will arrange any appropriate prior security clearances.

(b) The premises of any user may be inspected at all reasonable hours for the purpose of determining whether any violation of this chapter exists.

(c) When required by the director, the owner(s) of any property serviced by a building sewer carrying industrial wastes shall install a suitable structure(s) together with such necessary meters and other appurtenances in the building sewer to facilitate observation, sampling and measurement of the wastes. Such structure, when required, shall be accessible and safely located, and shall be contructed in accordance with plans approved by the director. The structure shall be installed by the owner(s) at his expense and shall be maintained by him so as to be safe and accessible at all times. Following approval and installation, such meters may not be removed without the consent of the director.

(d) If a user refuses to grant the director entry upon request, the director may seek an administrative warrant for an inspection from any court authorized to issue search warrants under Michigan law. In an emergency which creates an immediate and substantial danger to persons or property, the premises of a user may be inspected at any time and without permission or a warrant.

(e) Trade secrets or patented processes disclosed to the city under this chapter shall be confidential and exempt from release to nongovernmental persons, in accordance with Section 13(1)(g) of the Michigan Freedom of Information Act, except as such release is required by law or regulations of the United States. Any data used to determine compliance with this chapter or the NPDES permit shall be available to the public. (Ord. No. 1373, § 2, 3-10-86)

Sec. 28-18. Rules and regulations.

(a) With approval of the city commission and for the purpose of preventing, discontinuing or correcting any violations of this chapter, the director may adopt and establish rules and regulations for the enforcement of this chapter.

(b) Rules and regulations adopted under this section may include, but are not limited to, imposing requirements upon industrial or commercial users to submit plans for the pretreatment of waste water, to install equipment to monitor the nature and quantity of the waste water being discharged into the system, and/or to keep records. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-19. Reserved.

Editor's note—Section 28-19, pertaining to the industrial cost recovery system, and derived from Ord. No. 1190, § 1, adopted March 3, 1980, was repealed by Ord. No. 1373, § 3, adopted March 10, 1986.

Sec. 28-20. Discharge of storm water; connections outside city.

(a) *Storm water discharges.*

(1) No person(s) shall discharge or cause or permit to be discharged into the waste water system, any unpol-

luted waters, or any storm water, ground water, roof drain runoff, subsurface drainage, footer drain discharge, cooling water or similar liquid, except that storm water runoff from limited areas may be discharged into the waste water system if the director has determined that said discharge will not adversely impact upon the waste water system or its operation.

(2) Whenever the director shall find that any provision of this section is being violated, he shall issue a written order to the person(s) responsible for such condition(s), to remove such connectors or drains from such sanitary sewer and to cease said unlawful discharge within ninety (90) days after service of such order.

(3) The service of such order, as mentioned herein, may be made upon the person to whom it is directed, either by delivering a copy of same to such person, or by delivering the same to and leaving it with any person in charge of the premises, or by affixing a copy thereof in a conspicuous place on the entrance of such premises.

(4) Storm water other than that exempted under the first paragraph of this subsection and all other unpolluted drainage shall be discharged to such sewers as are specifically designated as storm sewers or to a natural outlet approved by the director and other regulatory agencies. Unpolluted industrial cooling water or process waters may be discharged, on approval of the director and other regulatory agencies, to a storm sewer or natural outlet.

(b) *Sewer connections outside corporate limits.* Whenever sewers are about to be or have been constructed for the purpose of carrying off waste water from lots and lands outside the corporate limits, no permission shall be given or granted to connect such sewers with the treatment works of the city, nor shall the use of the treatment works be permitted for the waste water from such lots and lands outside of the corporate limits, unless there shall have been secured written permission from the director which shall be given only if the sewers or system of sewers for which such connection or use is sought conform to the plans theretofore adopted by the City of Kalamazoo. A certificate of approval of such sewers by the Michigan Department of Natural Resources shall also be furnished where, by law, such plans are required to be approved. (Ord. No. 1190, § 1, 3-3-80)

Secs. 28-21—28-23. Reserved.

ARTICLE II. SERVICE CHARGES*

Sec. 28-24. To be charged for all connections; basis, meters.

(a) The rates to be charged for waste water service furnished by the waste water system shall be charged to all buildings or premises having any connection with the system. Such rates shall be based upon the water consumption of the user's premises, including water from public and private supplies, or at the election of the user, the amount of waste water discharged into the city's waste water system, except that the service charge shall be based upon the size of the water meter.

(b) The owner of any building or premises receiving water from any source other than the city water department shall register the same with the director and shall arrange to have suitable metering facilities installed at his own expense to measure such private supply. The meters shall be provided, maintained and read by the water department, for which the customer shall be charged the applicable water service charge in addition to the established charges for waste water services. In any interim period allowed by the director prior to such installation, the director may establish such charges as he deems equitable, considering the anticipated waste water discharge.

*Cross reference—Water service charges, § 38-32 et seq.

(c) Any user of the wastewater system may elect to rearrange his water supply pipes and metering, for the purpose of eliminating from the total water consumption applicable to wastewater charges the water not running to the sanitary sewers, or he may elect to establish metering facilities registering the discharge from his premises to the sanitary sewers. All such arrangements shall be made subject to the approval of the director, and the expense thereof, including installation, maintenance and operation, shall be borne by the user.

(d) No statement contained in this section shall be construed as preventing any special agreement or arrangement between the city and any industrial user whereby an industrial waste of unusual strength or character may be accepted by the city for treatment. Any user who enters into a special agreement or arrangement with the city shall be subject to all user and industrial costs or fees established in the special agreement. No special agreement shall be entered into which is in conflict with Section 307 of Public Law 92-500 or with any other state or federal law or regulation. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-25. Rates established.

(a) Each user of the treatment works shall pay charges equal to the sum of those set out in subsections (1) and (2) below, according to the service charge (meter reading, billing expense and allocated infiltration/inflow costs) in (1) and the commodity charge (quantity of wastewater at average domestic strength and septic haulers at higher strengths as indicated) in (2). For nonmaster metered municipal (wholesale) customers (City of Galesburg and a portion of the City of Portage), the commodity charge has been increased above the master metered municipal (wholesale) customers (City of Galesburg and a portion of the City of Portage), the commodity charge has been increased above the master metered municipal (wholesale) customer class to account for infiltration and inflow.

Industrial users who are subject to the requirements of federal regulations as promulgated by the United States Environmental Protection Agency shall also pay industrial surveillance and industrial pretreatment program charges (laboratory tests, surveillance costs, inspection charges per laboratory test) in (3) below.

Commercial or industrial customers whose wastewater strengths are monitored and tested by City Technical Services staff shall pay quantity/quality charges (quantity, BOD, SS and NH_3) in (4) below. Any commercial or industrial customer, who is not monitored by City Technical Services staff, and who believes that their wastewater strengths are below average domestic strengths (BOD—236 mg/l, SS—168 mg/l, NH_3—23 mg/l) may document their wastewater strengths to the satisfaction of the director (or pay the cost of sampling and testing by City Technical Services staff) and shall be allowed to pay quantity/quality rates in (4) below.

Septage haulers whose wastewater strengths are below the amounts in (2) below may document their wastewater strengths to the satisfaction of the director (or pay the cost of sampling and testing by city technical services staff) and shall be allowed to pay quantity/quality rates in (4) below.

Charges within each subsection are listed by OM&R (operation, maintenance and replacement) cost and capital costs when applicable. The system of OM&R and capital charges shall be reviewed annually and revised periodically as required to maintain the proportionality of charges and generate sufficient revenue to meet revenue requirements:

(1) *Service charges.* The following service charges shall apply to all users connected or required to be connected regardless of quantity of wastewater discharged. The service charge is a user charge, and it contains billing and inflow and infiltration charges for retail customers. For municipal (wholesale) customers with a master meter, the service charge contains billing costs only, since inflow and infiltration are included in their metered flows.

Service charges (minimum charges per billing period):

Inside City, Quarterly

Meter Size (inches)	*OM & R ($/bill)*	*Capital ($/bill)*	*Total ($/bill)*
5/8	6.22	1.98	8.20
3/4	6.56	2.18	8.74
1	7.60	2.77	10.37
1 1/2	8.99	3.56	12.55

Inside City, Quarterly

Meter Size (inches)	*OM & R ($/bill)*	*Capital ($/bill)*	*Total ($/bill)*
2	12.80	5.74	18.54
3	40.88	21.77	62.65
4	51.28	27.70	78.98
6	75.54	41.56	117.10

Outside City, Quarterly

Meter Size (inches)	*OM & R ($/bill)*	*Capital ($/bill)*	*Total ($/bill)*
5/8	6.22	4.44	10.66
3/4	6.56	4.89	11.45
1	7.60	6.22	13.82
1½	8.99	7.99	16.98
2	12.80	12.88	25.68
3	40.88	48.84	89.72
4	51.28	62.16	113.44
6	75.54	93.25	168.79

Inside City, Monthly

Meter Size (inches)	*OM & R ($/bill)*	*Capital ($/bill)*	*Total ($/bill)*
5/8	3.91	0.66	4.57
3/4	4.02	0.73	4.75
1	4.37	0.92	5.29
1½	4.83	1.19	6.02
2	6.10	1.91	8.01
3	15.46	7.26	22.72
4	18.93	9.23	28.16
6	27.02	13.85	40.87
Municipalities	–	–	–
Dewatering	2.75	–	2.75
Septage haulers	2.75	–	2.75

Outside City, Monthly

Meter Size (inches)	*OM & R ($/bill)*	*Capital ($/bill)*	*Total ($/bill)*
5/8	3.91	1.48	5.39
3/4	4.02	1.63	5.65
1	4.37	2.07	6.44
1½	4.83	2.67	7.50
2	6.10	4.29	10.39
3	15.46	16.28	31.74

Outside City, Monthly—Cont'd.

Meter Size (inches)	*OM & R ($/bill)*	*Capital ($/bill)*	*Total ($/bill)*
4	18.93	20.72	39.65
6	27.02	31.08	58.10
Municipalities	2.75	–	2.75
Dewatering	2.75	–	2.75
Septage haulers	2.75	–	2.75

(2) *Commodity charges:*

Inside City

	OM & R ($/m³)	*Capital ($/m³)*	*Total ($/m³)*
Residential*	0.249	0.078	0.327
Commercial	0.249	0.078	0.327
Industrial	0.249	0.078	0.327
Dewatering	0.249	0.078	0.327
Septage haulers**	11.273	1.233	12.506

Outside City

	OM & R ($/m³)	*Capital ($/m³)*	*Total ($/m³)*
Residential*	0.249	0.157	0.406
Commercial	0.249	0.157	0.406
Industrial	0.249	0.157	0.406
Dewatering	0.249	0.157	0.406
Septage haulers**	11.273	1.233	12.506
Municipalities:			
Master-metered	0.185	0.043	0.228
Nonmaster-metered	0.201	0.050	0.251

m^3 = cubic meters

*Summer water consumption used in calculation of wastewater bills shall not exceed 120% of winter quarter consumption for quarterly users whose winter quarter water consumption is less than two hundred (200) cubic meters and monthly customers whose winter quarter water consumption does not exceed sixty-six (66) cubic meters per month.

**Septage haulers average strength wastewater: BOD—6,000 mg/l, SS—14,000 mg/l and Ammonia—157 mg/l.

(3) *Industrial surveillance and industrial pretreatment program charges:*

	OM&R	*Capital*	*Tota*
Industrial surveillance charges:			
Laboratory test—$/test	3.90	–	3.9
Other surveillance costs—$/sample	84.00	–	84.0
Industrial pretreatment program.			
Program charges per lab test—$/test	66.13	0.17	66.3

(4) *Quality/quantity charges:*

		Quantity Charge	
	OM&R ($/m³)	*Capital ($/m³)*	*Tota ($/m*
Monitored customers:			
Upjohn	0.039	0.019	0.05
Georgia Pacific	0.072	0.027	0.09
James River	0.054	0.019	0.07
Dewatering:			
Inside city	0.103	0.059	0.16
Outside city	0.103	0.133	0.23
Industrial—Inside city	0.103	0.059	0.16
Industrial—Outside city	0.103	0.133	0.23
Septic haulers	5.061	0.015	5.07

m³ = cubic meters

		BOD Strength Charge	
	OM&R ($/kg)	*Capital ($/kg)*	*Totc ($/k*
Monitored customers:			
Upjohn	0.342	0.032	0.37
Georgia Pacific	0.342	0.032	0.37
James River	0.342	0.023	0.36
Dewatering:			
Inside city	0.342	0.023	0.36
Outside city	0.342	0.032	0.3
Industrial—Inside city	0.342	0.023	0.3
Industrial—Outside city	0.342	0.032	0.3
Septic haulers	0.342	0.032	0.3

	SS Strength Charge		
	OM&R ($kg)	Capital ($/kg)	Total ($/kg)
Monitored customers:			
Upjohn	0.289	0.071	0.360
Georgia Pacific	0.289	0.071	0.360
James River	0.289	0.056	0.345
Dewatering:			
Inside city	0.289	0.056	0.345
Outside city	0.289	0.071	0.360
Industrial—Inside city	0.289	0.056	0.345
Industrial—Outside city	0.289	0.071	0.360
Septic haulers	0.289	0.071	0.360

	NH_3 Strength Charge		
	OM&R ($/kg)	Capital ($/kg)	Total ($/kg)
Monitored customers:			
Upjohn	0.725	0.205	0.930
Georgia Pacific	0.725	0.205	0.930
James River	0.725	0.149	0.874
Dewatering:			
Inside city	0.725	0.149	0.874
Outside city	0.725	0.205	0.930
Industrial—Inside city	0.725	0.149	0.874
Industrial—Outside city	0.725	0.205	0.930
Septic haulers	0.725	0.205	0.930

kg = kilograms

(b) In addition to the above charges, each user shall pay the charges for miscellaneous service and monitoring, as determined by the director. The charges may be revised by the director whenever, in his opinion, it is deemed appropriate. All charges shall be paid to the Department of Public Utilities, and all funds received as a result of the miscellaneous charges will be credited to the wastewater system receiving account.

(c) Any person or entity who is responsible for discharging prohibited material shall be charged the actual expense incurred by the city for the handling, treatment and/or removal of said material in the wastewater system.

(d) Any person or entity who is responsible for damage to the wastewater system shall be charged the full cost of repair of the damage to the wastewater system. The cost shall include but is not limited to labor, equipment, materials, administrative expense, interest on borrowed funds, engineering, legal or other professional fees or expenses charged to the city by other utilities or departments and any and all fines, costs, penalties or damages imposed upon the city by the United States, the State of Michigan or any court or administrative agency.

(e) Customers will be notified at least once per year how much they are being charged for their proportional operation, maintenance and replacement costs, as required by United States Environmental Protection Agency regulations. (Ord. No. 1190, § 1, 3-3-80; Ord. No. 1293, § 1, 10-3-83; Ord. No. 1339, § 1, 1-28-85; Ord. No. 1370, § 1, 3-10-86; Ord. No. 1405, § 1, 2-16-87; Ord. No. 1507, § 1, 12-31-90)

Sec. 28-26. Classification of users for billing purposes.

(a) Users of the treatment works shall be divided into classes. Classes shall be groups of users for which the wastewater characteristics are approximately equal and services provided are essentially the same. Classes and subclasses of users are hereby established for capital charges as follows:

NONINDUSTRIAL USER CLASS—As defined in section 28-1:

1. Individually metered
   1.1. Inside city
   1.2. Outside city
2. Master metered
   2.1. Outside city

INDUSTRIAL USER CLASS—As defined in section 28-1:

3. Individually metered
   3.1. Inside city
   3.2. Outside city
4. Contract industries served by Riverview Pumping Station.
5. Contract industries not served by Riverview Pumping Station.

The user charges shall result in the distribution of operation, maintenance and replacement costs of the treatment works within the jurisdiction of the city to each user class in proportion to such user's contribution of the total wastewater loading of the treatment works. Factors such as strength, volume and delivery flow rate characteristics shall be included to ensure a proportional distribution of the costs. The director may establish additional classes are determined to be necessary.

(b) The demand charge provided in subsection 28-25(a)(1) applicable to single-family residences within the individually metered nonindustrial class shall be computed on the basis of the size of water meter actually installed on the water service to the residence.

(c) The commodity user charge provided in subsection 28-25(a)(2) for individually metered users in both the industrial and nonindustrial classes and the contract industrial users shall include the cost of treating wastewater with a level of pollutants up to and including 250 mg/l BOD_5 or 625 mg/l COD and 290 mg/l SS.

The commodity user charge provided in subsection 28-25(a)(2) for master metered users in the nonindustrial class shall include the cost of treating wastewater with a level of pollutants up to and including 230 mg/l BOD_5 and 260 mg/l SS.

(d) Residential customers and other small users whose water consumption as purchased from the water department is less than two hundred (200) cubic meters during the winter quarter shall be billed for wastewater service in the other three (3) quarters on the basis of the actual consumption of water with a maximum quantity for any quarter equal to one hundred twenty (120) per cent of the winter quarter. The *winter quarter* is defined as a three-month billing period between November first of any one (1) year and April thirtieth of the subsequent year (both dates inclusive) in accordance with water meter reading and billing schedules as used by the water department. Where it is evident that the water consumption during the winter quarter does not fairly reflect the yearly consumption for nonsprinkling purposes, the director may use such three-month period or average as reasonably appears to reflect normal waste after discharge from that residence as a basis for the wastewater disposal service bill. All other users shall be billed on a basis of water actually used in every billing period or actual wastewater discharged through a meter. (Ord. No. 1190, § 1, 3-3-80; Ord. No. 1495, § 3, 5-14-90)

Sec. 28-27. Applicability of demand charge to property not connected to sewer.

Properties which have water service or a water supply and abut a sanitary sewer and have not been connected thereto shall become liable for payment of the demand charge prescribed in section 28-25 upon the expiration of a five-year period following the date when the sanitary sewer was accepted by the city as being ready for use. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-28. Reserved.

Sec. 28-29. Billing, responsibility for payment.

Wastewater service charges shall be billed quarterly, except that customers billed monthly for water shall be billed monthly for the wastewater service charge. The person paying or responsible for payment of the water bill shall, in like manner, be responsible for payment of the wastewater service bill. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-30. When due and payable; penalty and interest for delinquency.

All charges for wastewater service shall become due and payable on the date indicated on each bill. Payments made after such date shall include an additional five (5) per cent of the amount due on the due date. (Ord. No. 1190, § 1, 3-3-80)

Sec. 28-31. Charges as lien; collection by suit, discontinuing wastewater service for failure to pay.

(a) The charges for wastewater service are hereby recognized to constitute a lien on the premises receiving such service. This lien shall become effective immediately upon providing wastewater service to the premises but shall be not enforceable for more than three (3) years after it becomes effective. Whenever any such charge against any property shall be delinquent for three (3) months, the city officials in charge of the collection thereof may certify to the tax assessing officer of the city the fact of such delinquency, whereupon such charge shall be entered upon the next roll as a charge against such premises and shall be collected and the lien thereof enforced in the same manner as general city taxes against such premises are collected and the lien thereof enforced. Nothing in this section, however, shall be deemed to prevent the city from suing in a court of law to collect the amount due it for wastewater service charges as provided in subsection (c) below. In addition to the other remedies provided in this section, the city shall have the right to shut off and discontinue the supply of water service to any premises for the nonpayment of wastewater service charges when due in accordance with the procedure established in subsection (b) below.

(b) If a charge for wastewater service prescribed by this article is not paid within thirty (30) days after the billing therefor, and after the customer has been given notice and an opportunity to be heard as provided by law, all water service may be shut off and discontinued to the customer owing or liable for such charge. Water service shut off pursuant to this section shall not be restored until all sums due and owing have been paid in full, including a collection fee of ten dollars ($10.00) and appropriate security deposits as prescribed by resolution of the city commission.

(c) At its option the city may, in addition to the remedies above, in its corporate name, bring suit in any court of competent jurisdiction for the collection of any wastewater service charge which, thirty (30) days after the billing therefor, has not paid. The production of the meter record or cost record shall be prima facie evidence of the liability to pay the amount therein shown to be due. (Ord. No. 1190, § 1, 3-3-80; Ord. No. 1273, § 1, 11-1-82)

Sec. 28-32. Disposition of revenue.

(a) The revenues of the wastewater system derived from the collection of rates established by this article are hereby ordered to be credited, as collected, to a separate account to be designated as the wastewater system receiving account (hereinafter referred to as the receiving account) and the revenues in such account shall be credited to the following accounts quarterly in the manner hereinafter specified for the purposes therein mentioned.

The revenues of the waste water system may be deposited in such bank accounts and with such depositories as the city commission may, by resolution or ordinance, designate.

(b) Out of the revenue in the receving account, there shall be credited quarterly to a separate account, designated as the operation and maintenance account, all funds collected from user charges to be used for the administration and operation of the system, including billing, accounting, postage and related costs, and such current expenses for the maintenance thereof as may be necessary to preserve the same in good repair and working order.

(c) There shall next be established and maintained a separate account, designated as the debt retirement account, which account shall be used solely and only for the purpose of paying the principal of and interest on the bonds of the system as are now or may hereafter be issued, except special assessment bonds. Any tax revenues designated for use in retiring such bonds shall likewise be credited to this account as and when received. There shall be set aside from time to time in such account at least a sufficient amount to meet the principal and interest requirements accruing in the current fiscal year.

(d) After all such funds have been credited as above provided, the revenues derived from the charges collected and taxes designated as aforesaid may be used for the purpose of construction, expansion, extension and improvement of the system.

(e) Any surplus "capital charge" revenues remaining at the end of any fiscal year, after the above requirements have been met, shall be credited to the system surplus account and shall be disposed of as directed by the city commission. (Ord. No. 1190, § 1, 3-3-80)

[The next page is 1767]

APPENDIX I

GROUNDWATER EXTRACTION SYSTEM ANALYSIS

Groundwater Extraction System Analysis

Prepared for:
eder Associates
Auto-Ion PRP Group

Prepared by:
Conestoga-Rovers & Associates
1 June 1992

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GROUNDWATER EXTRACTION SYSTEM ANALYSIS

1.0 INTRODUCTION

This report presents an analysis of groundwater flow for the Auto-Ion site located in Kalamazoo, Michigan. The purpose of this analysis was to evaluate various configurations of groundwater pumping systems considered in the feasibility study (FS). This analysis was conducted by Conestoga-Rovers & Associates, as authorized by Eder Associates and the Auto-Ion site PRP group, as part of the feasibility study for operable Unit II.

1.1 General Setting

The Auto-Ion site is located at 74 Mills Street in the City of Kalamazoo, Michigan immediately adjacent to the Kalamazoo River. Figure 1 shows the general location of the site within the City. This section of the City is a commercial/industrial district as illustrated in Figure 2. The site itself occupies approximately 1.5 acres and is square in shape, measuring roughly 250 feet on a side.

Historically, the City of Kalamazoo operated an electrical generating station at this location from the 1940s until 1956. In 1956 Consumers Power Company purchased the generating plant, and shortly thereafter closed and dismantled the facility.

The Auto-Ion Chemical Company (AICC) initiated operations at the site in 1964. Initial operations involved industrial waste water treatment activities, specifically the treatment of electroplating wastes. AICC received waste materials containing chrome and cyanide. The treatment operations involved destruction of the cyanide and precipitation of heavy metals. The sludge from the precipitation operations was disposed in an on-site lagoon. AICC activities ceased in 1973. Waste materials, both containerized and uncontainerized, remained at the facility after cessation of operations.

The site was placed on the National Priorities List (NPL) in 1982. OH Materials Corp., on behalf of a certain number of the Potentially Responsible Parties, removed debris and conducted a clean-up of the ground surface area in 1983. Following this general clean-up activity, the building that was on-site was demolished under the direction of the City of Kalamazoo. From that time until the present day, the surface of the site has remained essentially unchanged.

During 1987 and 1988 a remedial investigation was conducted to define the subsurface soil and groundwater conditions at the site. This investigation defined the geologic, hydrogeologic and chemical conditions. These RI data were reviewed to obtain an understanding of subsurface conditions and to provide input to this groundwater extraction system analysis.

1.2 Study Objectives

The objectives of this study were to develop information on hydraulic flow rates for pumping system input to provide comparative evaluation of alternatives in the feasibility study.

The specific objectives of this study were to:

(1) Evaluate groundwater extraction system pumping rates required to achieve hydraulic capture within the site boundary;

(2) Evaluate the impact of varying hydraulic conductivities on extraction system pumping rates; and

(3) Evaluate the effectiveness of a partial vertical hydraulic barrier.

2.0 CONCEPTUAL MODEL

A preliminary engineering analysis of site conditions indicated that the subsurface soils were relatively permeable, and a remedial extraction system had the potential of inducing significant groundwater flows from the Kalamazoo River. Several engineering alternatives were developed to control groundwater flow, yet maintain a relatively low extraction system flow rate. These alternatives included:

- Management of groundwater pumping so that groundwater drawdowns were not excessive; and

- Installation of a hanging barrier wall to retard lateral groundwater flow from the Kalamazoo river.

The quantitative evaluation of these engineering alternatives was pursued through numerical analysis. The basic items to be addressed included:

- The extraction system flow rate required to maintain groundwater flow control across the Auto-Ion site area;

layer of organic peat were also reported. These types of interbedded deposits are characteristic of the outwash fluvial depositional process. These interbedded deposits constitute the aquifer soil materials.

Cross-sections of subsurface conditions were drawn to illustrate the geology. Figure 4 shows the location of two cross-sections, one through the eastern portion of the site area and the other through the western portion. Figure 5 shows the cross-section through the eastern portion of the site. Overall, subsurface conditions can be described as a sandy material extending to a depth of approximately 100 feet which is overlain by a fill material which extends to a depth of approximately 5 to 8 feet below ground surface. Gravels were also present in the sandy aquifer material. The southern portion of the site adjacent to the River appears to have a small lense of black clay/peat material at the top of the sandy deposits, immediately below the fill material. The aquifer soil materials are predominantly composed of sandy materials. The black clay/peat lense is present just below the top of the groundwater table.

The cross-section on the western side of the site area is shown in Figure 6. This cross-section has essentially the same site conditions as noted in the previous cross-section, with the exception of the presence of a gray silt and clay layer at a depth of approximately 17 to 27 feet. This silt and clay lense appears to be present only in the northwestern and west-central portions of the site area and pinches out toward the River. The lense of black clay material adjoining the Kalamazoo River is also present on the southern portion of the site, and it appears that this clay lense is relatively contiguous at the top of the groundwater table along the site boundary adjoining the Kalamazoo River.

Soil borings B-1 and B-3 were drilled to depths in excess of 100 feet. These borings show that the sandy soil materials are underlain by a shale bedrock, which was encountered at a depth of 97 feet (B-3) and 109 feet (B-1).

2.2 Groundwater Flow System

The aquifer of concern beneath the Auto-Ion site is an unconfined aquifer extending to a depth of approximately 100 feet. The top of the groundwater table is in the range of 5 to 10 feet below ground surface, and thus the saturated flow thickness of the aquifer is roughly 90 to 95 feet. The aquifer soil material is a fine to coarse grained sand. The cross-sections illustrated in Figures 5 and 6 indicate that this sandy aquifer material is interbedded with silts and clays. These interbedded lenses are up to 10 feet thick in some locations.

Groundwater level data were collected during conduct of the remedial investigation. These data indicate that the groundwater table throughout the site area has less than a foot of variance. The groundwater table also appears to respond to fluctuations in the adjoining Kalamazoo River. The data do indicate that the River is generally a receiving stream; that is, groundwater flow is predominantly toward and into the River. During periods of elevated River levels, however, the River does appear to recharge the aquifer.

The aquifer is also locally recharged by precipitation infiltration throughout the site area. The reported surface conditions indicate that the land areas adjoining the Auto-Ion site are developed and largely paved. Given these conditions, precipitation infiltration over the land areas adjoining the Auto-Ion site would be relatively minimal. The Auto-Ion site area itself is unpaved and undeveloped.

Thus, precipitation infiltration over the site area would be expected to be higher than in the adjoining areas.

The average annual rainfall for the Kalamazoo, Michigan area is approximately 35 inches per year. The majority of precipitation does not infiltrate to the subsurface, but rather runs off into surface streams. The southwestern Michigan area is identified as a relatively high run-off area (Hunt, 1967). A conservatively high estimate of infiltration for the site area would be 10 inches per year. If the numerical analysis indicates that groundwater flow control can be achieved with this high infiltration rate, then lesser amounts of infiltration will not diminish system operation.

Overall, the following conditions concerning the groundwater flow system beneath the Auto-Ion site can be derived from the available data.

- o The groundwater aquifer is unconfined with a saturated flow thickness of approximately 90 to 95 feet. The top of the groundwater table is at a depth of 5 to 10 feet below ground surface.

- o The aquifer soil materials are predominantly a fine to coarse grained sand material. These sandy deposits are horizontally bedded and contain lenses of silt and clay, which range up to 10 feet in thickness. The sandy soils also contain small lenses and seams of gravelly deposits. A relatively contiguous lense of black clay/peat material is present just below the top of the groundwater table along the site boundary adjacent to the Kalamazoo River.

- o Precipitation infiltration over the Auto-Ion site area itself will be greater than for the areas adjoining the Auto-Ion property. The adjoining properties are developed and paved, which promotes surface water run-off and reduces infiltration.

- The predominant flow of the groundwater system beneath the Auto-Ion site is toward the Kalamazoo River. The groundwater table, however, has very little relief and during conditions of elevated River levels, the flow would be from the River toward the site area.

These general groundwater flow system evaluations were used to establish the hydrogeologic boundaries and properties of the site in preparation for the numerical analysis.

2.3 Hydrogeologic Boundaries and Properties

The available data indicate that groundwater flow is generally toward and into the Kalamazoo River from the adjoining land area. This general flow pattern formed the basis for establishing the boundary conditions of the numerical analysis. Figure 7 identifies these boundary conditions. The south boundary of the site is a discharge boundary to the River. Groundwater flow enters the site area across the north boundary.

Precipitation infiltration over the site area itself appears to be greater than in the adjoining land areas, and therefore is anticipated that a slight groundwater mound may be present under the site at times. The presence and extent of this mound would depend upon precipitation conditions as well as River stage conditions.

Groundwater movement along the east and west sides of the site may be outward from the site area at the times when groundwater mound is present.

Overall, however, it is anticipated that this outward flow would be very minimal and that flow would essentially parallel the east and west site boundaries toward the Kalamazoo River.

The hydraulic conductivity of the aquifer was measured via slug testing during the remedial investigation. The measured values range from 1.1×10^{-3} to 2.19×10^{-2} cm. per sec. with an average of 1.16×10^{-2} cm. per sec. These measurements of hydraulic conductivity were taken such that they represent the horizontal component of groundwater flow. Measurements of vertical hydraulic conductivity were not conducted during the remedial investigation. It is anticipated, however, based upon the geology of the site, that the vertical conductivity will be lower than the horizontal conductivity.

The above conditions and descriptions of geologic and hydrogeologic conditions were used to evaluate flow conditions in the aquifer with respect to the different types of extraction system configurations.

2.4 Hanging Barrier Wall Impact on Groundwater Flow

The objective of the Auto-Ion extraction system would be to withdraw groundwater from beneath the Auto-Ion site such that groundwater flow across the site area would be directed toward the pumping system. Since the hydraulic conductivity of the aquifer is relatively high and the aquifer is hydraulically linked to the Kalamazoo River, flow rates from this pump system could potentially be quite high. Elevated flow rates would be expected, particularly if the Kalamazoo River provided significant recharge to the aquifer during pumping operations.

Horizontal flow in groundwater aquifers can be reduced by use of barrier walls. Typically, these barrier walls intersect the full vertical thickness of the aquifer and serve to contain groundwater flow throughout the entire saturated flow thickness. When the depth of the lower confining bed is greater than 50 to 70 feet, however, consideration is given to a hanging barrier wall. A hanging barrier wall cuts off the flow of groundwater in the upper portion of an aquifer and in this manner reduces the quantity of horizontal flow.

Figure 8 illustrates the principle of groundwater flow reduction associated with a hanging barrier wall. In the upper portion of the Figure, normal groundwater flow is shown. Under these conditions, groundwater need only move a few feet in the upper portion of the aquifer to travel from the recharge area to the groundwater collection system.

The impact of a hanging barrier wall is illustrated in the lower portion of Figure 8. When the hanging barrier wall is present, the groundwater flow pattern is routed vertically downward from the recharge area, around the bottom of the hanging barrier wall and then upward to the collection system. Since groundwater head conditions at the drain and the River with and without the barrier wall are unchanged, only the length of the groundwater flow path is increased by the barrier wall. If the length of the flow path is increased by a factor of 2, the groundwater flow gradient will be reduced by a factor of 2, as will the quantity of groundwater collected by the drain system. Thus, the presence of the hanging barrier wall has lengthened the groundwater flow path, and correspondingly decreased the groundwater gradient such that a reduction in the groundwater extraction rate is achieved.

The above example is provided for the case where the horizontal and vertical hydraulic conductivity of the aquifer are identical. Horizontally stratified soil materials generally have a lower vertical hydraulic conductivity than horizontal conductivity. This difference in conductivities is most significant in fluvial and outwash type deposits, such as the deposits beneath the Auto-Ion site. When different horizontal and vertical conductivities are present, the impact of the hanging barrier wall can even be more significant.

Referring to the lower portion of Figure 8, assume that the vertical hydraulic conductivity of the aquifer materials is one order of magnitude lower than the horizontal conductivity. In this case the lengthened groundwater flow path is through sediments of lower hydraulic conductivity. Thus, not only is the gradient of the flow reduced, but the hydraulic conductivity along the flow path is also reduced. If the flow path is lengthened by a factor of 2 and the hydraulic conductivity reduced by an order of magnitude, the total impact on flow collected by the groundwater extraction system would be a 20-fold reduction.

Implementation of a hanging barrier wall can reduce groundwater flow to a groundwater extraction system, while maintaining the objectives of the remedial pumping system. In order to evaluate the impact of a hanging barrier wall on groundwater flow at the Auto-Ion site, a comparative analysis of flow conditions was made both with and without a barrier wall. The groundwater model numerical codes discussed below were used to solve the equations of flow associated with this comparative analysis.

3.0 COMPUTER CODE DESCRIPTION

Two types of numerical analyses were conducted to evaluate groundwater flow at the Auto-Ion site. Both sets of analyses utilized numerical groundwater modeling code. Since this analyses was a comparative evaluation, however, classical predictive groundwater modeling work was not conducted. The objective of these comparative analyses is discussed in section 1.2 of this report.

The FLOWPATH and FLONET numerical modeling codes were utilized during this assessment. The FLOWPATH code is described as a two-dimensional horizontal aquifer simulation model. FLOWPATH calculations include steady state hydraulic head distributions and groundwater seepage velocities.

FLOWPATH uses the finite difference method to solve the governing groundwater equation for two-dimensional steady state horizontal flow.

$$\frac{\partial}{\partial x}\left(T_{xx}\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(T_{yy}\frac{\partial h}{\partial y}\right)\pm Q(x,y)=0$$

This finite difference method has been commonly used in groundwater modeling by Pinder and Bredehoeft, 1968; Prickett and Lonnquist, 1971; Kinzelbach, 1986; and McDonald & Harbaugh, 1984. When conducting a finite difference analysis, the partial differentials of X and Y in the above equation are approximated by finite lengths, termed ΔX and ΔY. The aquifer is then subdivided or discretized into a number of blocks, each block having side lengths of ΔX and ΔY as well as a thickness, termed b. The governing equation takes the form of a fluid mass balance formulated from an ensemble of finite volumes of the aquifer.

The two-dimensional formulation neglects any vertical gradients of hydraulic heads and velocities.

A complete description of the FLOWPATH model can be obtained from Waterloo Hydrogeologic Software located at 113-106 Seagram Drive, Waterloo, Ontario, Canada N2L 3D8.

The numerical code associated with the FLONET software was also utilized when conducting this analysis. The FLONET numerical code is described as a two-dimensional steady state FLONET generator.

Groundwater flow systems, although inherently three-dimensional, can often be adequately approximately by an evaluation of flow conditions in the two-dimensional areal plane, and the vertical cross-section. When hydrogeological conditions have significant vertical variation of physical properties or significant vertical flow gradients, the numerical analysis is most appropriately approached by a two-dimensional vertical cross-section analysis. The FLONET numerical code provides for such an analysis.

The FLONET numerical code provides for an effective interpretation of groundwater flow in the vertical cross-section. Groundwater flownets which illustrate both the hydraulic potential distribution and groundwater flow paths are utilized in this analysis. These groundwater flownets are numerically simulated by formulating the problem in terms of hydraulic potential and stream function, using what is known as the dual formulation method (Frind & Matanga, 1985). Besides providing a unique visual perspective of the groundwater flow pattern, use of stream functions is generally more accurate than using hydraulic potentials in deriving flow velocities. The dual formulation approach is restricted to saturated, steady state hydrogeological systems.

A more complete description of the FLONET numerical code can be obtained from the Waterloo Centre for Groundwater Research, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1 or from Waterloo Hydrogeologic Software at the address identified above.

4.0 GROUNDWATER FLOW MODEL CONSTRUCTION

Flow conditions associated with an aquifer pumping system, (both with and without a hanging barrier wall) include both horizontal flow components and vertical flow components. The analysis of horizontal groundwater flow was accomplished through use of the FLOWPATH model numerical code. Since the horizontal and vertical hydraulic conductivities are not identical, the impact of the difference in vertical hydraulic conductivity with respect to horizontal conductivity was evaluated using the FLONET model numerical code.

4.1 Horizontal Groundwater Flow Analysis by FLOWPATH

The FLOWPATH model was constructed to simulate the general conditions of the Auto-Ion site area. Figure 9 identifies the model lay-out, grid size and boundary conditions. The aquifer was analyzed as unconfined flow with a saturated thickness of 100 feet. The aquifer soil materials themselves were assumed to be a sandy material having a constant hydraulic conductivity. Since the FLOWPATH numerical code is two-dimensional, the vertical hydraulic conductivity is equal to the horizontal conductivity. Homogeneous flow conditions were assessed with the FLOWPATH numerical code.

Numerical analyses were conducted for two sets of hydraulic conductivities, 1×10^{-2} cm. per sec. and 1×10^{-3} cm. per sec. The RI data indicate that the aquifer hydraulic conductivities are in this range.

One of the objectives of this analysis was to assess the overall groundwater withdrawal rate from a remedial extraction system. If it is assumed that the aquifer is homogeneous with a hydraulic conductivity of 1×10^{-2} cm. per sec., and the calculated flow rate required to attain groundwater control is acceptable, a more detailed assessment of groundwater flow conditions is not necessary at this time. The presence of finer grained silt and clay layers in the aquifer flow system will only serve to reduce the rate of groundwater flow to the extraction system. In effect, the numerical analysis of aquifer conditions assuming a relatively high hydraulic conductivity and homogeneous conditions is a worst case analysis. If groundwater flow rates from this analysis are acceptable, then flow rates from the groundwater system with conditions that further impede the flow will also be acceptable.

The model boundary conditions were based on reported site conditions. The site area itself was placed in the center of the modeled area so that boundary effects would not impact the flow analyses within the site area.

The north boundary of the model was established as a constant flux boundary. The rate of groundwater flux was set in accord with the assumed hydraulic conductivity of the aquifer. Groundwater flux was calculated using a 100 foot saturated flow thickness and an effective porosity of .25. The gradient of flow was assumed to be 0.005.

The east and west boundaries of the model were considered to be no flow boundaries. Since groundwater flow is toward the Kalamazoo River, the flow stream lines would parallel the east and west model boundaries. Since the site itself is well within the modeled area, the use of no flow boundaries on the east and west edges will have virtually no impact on flow conditions within the site area.

The south boundary of the model was established as a fixed head boundary to simulate the Kalamazoo River. The River was reported to be approximately 100 feet wide and 5 feet deep adjacent to the site area. These dimensions were considered in establishing the River boundary. In addition, the hydraulic connection between the River and the aquifer was assumed to be relatively high. That is, it was assumed that groundwater could readily pass into the Kalamazoo River and that River water could readily recharge the aquifer, depending upon head/stage conditions. There is some impedance to the flow of water between a porous media and a surface water body. In order to simulate this impedance, a finer grained layer of sediment/soil materials was assumed to be present at the bottom of the River, having a thickness of approximately 1 foot and a hydraulic conductivity of 1×10^{-4} cm. per sec.

Precipitation infiltration over the site area was taken at 10 inches per year. This is approximately a third of average annual precipitation and is a conservatively high estimate. The infiltration was assumed to occur only over the site since the adjoining properties are reportedly developed and paved.

The groundwater extraction system was simulated by three pumping wells installed in the center of the Auto-Ion site. Two different pump rates were used for these wells; that is, 4 gallons per minute per well (12 gpm total) and 10 gallons per minute per well (30 gpm total).

Since the FLOWPATH numerical code is designed for horizontal flow (two-dimensional) analysis, pumping wells are always considered fully penetrating. A partially penetrating well or a partially penetrating drain tile system cannot be assessed. The groundwater extraction system must remove groundwater from across the site area but should not act as a fully penetrating continuous barrier to groundwater movement. Therefore, analysis of a fully penetrating drain tile would have been inappropriate, and the three identified pump wells were deemed appropriate and adequate for this analysis.

The above groundwater flow simulations generally represent the overall conditions found at the Auto-Ion site. The barrier wall impact on groundwater flow rate is most effectively conducted as a comparative analysis. For the purposes of this comparative analysis, the important factor is that the overall conditions of groundwater flow generally represent site conditions and that the principal factors, such as hydraulic conductivity, aquifer flow thickness, and the like remain constant for both elements of the comparative analysis. In this regard, the identified set of flow parameters enumerated above is considered adequate and appropriate for the stated objectives of this feasibility study analysis.

4.2 FLOWPATH Numerical Analysis Results

The following aquifer conditions were assessed using the FLOWPATH numerical code:

(1) Three wells pumping at a combined rate of 12 gpm. This analysis used an aquifer hydraulic conductivity of 10^{-3} cm. per sec.

(2) Three wells pumping at a combined flow rate of 12 gpm. This analysis used an aquifer hydraulic conductivity of 10^{-2} cm. per sec.

(3) Three wells pumping at a combined rate of 30 gpm. This analysis used an aquifer hydraulic conductivity of 10^{-2} cm. per sec.

(4) Three wells pumping at a combined flow rate of 30 gpm. This analysis used an aquifer hydraulic conductivity of 10^{-2} cm. per sec. A barrier wall between the site area and the River was also simulated in this analysis.

The barrier wall referenced in the analysis was simulated to a depth of 50 feet into the upper portion of the aquifer. The flow barrier was considered to be impermeable. In order to conduct this partial depth barrier analysis using two-dimensional numerical code, a variant of the FLOWPATH Surface Water Bodies simulation was used. In conducting this analysis, the River was assumed to be 50 feet deep. The FLOWPATH documentation shows that when such a river depth is utilized, the horizontal boundary of the river is assumed impermeable and groundwater movement can only occur through the bottom of the simulated river. The bottom sediments in this analysis were given a permeability that was consistent with the overall aquifer conditions so that in effect the river acted hydraulically as a 5 foot deep channel with a vertical flow barrier extending to a depth of 50 feet. The details of this method of simulation can be found in section 3.1.4 of the FLOWPATH model documentation.

The results of the four groundwater flow analyses identified above are discussed in greater detail in the following subsections.

4.2.2 Higher Hydraulic Conductivity Using FLOWPATH

The remedial investigation data indicated that the aquifer hydraulic conductivity could range to 1 x 10^{-2} cm. per sec. This higher hydraulic conductivity would impact groundwater flow conditions during pumping operations and would result in the aquifer being able to transmit a greater amount of water.

The FLOWPATH numerical code was set up to simulate these higher hydraulic conductivity conditions and was used to assess the resultant flow conditions. Figure 11 shows the simulated groundwater flow pattern for three pumping wells withdrawing water from the aquifer at a total flow rate of 12 gpm (4 gpm per well). As can be seen, the overall groundwater flow is inward toward the Auto-Ion site area, however, the drawdown on the aquifer is minimal being only on the order of 0.5 foot to 1 foot. Practically speaking, this minimal amount of groundwater drawdown makes the system difficult to control during actual operations. Natural variations of the groundwater table will have an impact on groundwater flow patterns, and these natural variations exceed the 0.5 foot drawdowns being induced by the pumping wells (see section 4.5 of this report for further discussion).

If the aquifer has a higher hydraulic conductivity, it would be easier for the water to move toward the pumping wells and the drawdown would be reduced. In order to increase the drawdown around the pumping wells, the flow rate of the wells would need to be increased.

Another assessment was conducted with the extraction wells pumping at a rate of 30 gpm (10 gpm per well). Results of this assessment are shown in Figure 12. Comparison of Figure 12 to Figure 11 shows that even under increased groundwater flow conditions, the drawdown in the aquifer does not significantly increase. Overall, the hydraulic conductivity of the aquifer is sufficiently high that it can provide a relatively large quantity of water to the pumping wells. Thus, the pumping rate of the wells would need to be significantly increased to achieve notable groundwater drawdown.

Since the Kalamazoo River is approximately 150 feet from the simulated pumping well alignment, there is a potential for a significant amount of induced groundwater flow from the River at elevated pumping rates. If a barrier wall were placed between the site and the River it would function to limit this induced flow. This limitation would also increase groundwater drawdowns at the pumping wells. Therefore, a barrier wall extending downward through the upper half of the aquifer was evaluated.

The groundwater simulation for a barrier wall between the site and the River was conducted using a total well flow rate of 30 gpm. Figure 13 shows the location of the simulated barrier wall as well as the drawdown of the groundwater system. This analysis indicated that the groundwater gradient toward the pumping wells has been increased by approximately 1/2 foot to 1 foot due to the placement of the barrier wall. Thus, the barrier wall can be effective in enhancing groundwater drawdown at relatively low pump rates.

Overall, the conclusion of the analyses conducted using the FLOWPATH numerical code to evaluate higher aquifer hydraulic conductivities, is that the barrier wall is effective in promoting groundwater drawdowns at relatively low pumping rates. Thus, it appears that if the hydraulic conductivity of the aquifer is relatively high. a barrier wall will be needed to maintain acceptable groundwater drawdowns and relatively low pumping rates.

As stated above, the FLOWPATH numerical code is two-dimensional, and the impact on groundwater flow due to differences in horizontal and vertical hydraulic conductivity cannot be assessed. The barrier wall assessment using the FLOWPATH code, as discussed above, was for the upper half of the aquifer. Since the vertical hydraulic conductivity of the sediments are less than the horizontal hydraulic conductivity, the resulting groundwater gradient toward the pumping wells would be even greater than that simulated by the FLOWPATH assessment. Thus, the barrier wall could be even more effective in promoting groundwater drawdowns at low flow rates than was shown by the FLOWPATH analysis. In order to gain a better understanding of the overall impact of lower vertical hydraulic conductivities, an analysis of groundwater flow in the vertical profile was made through the use of the FLONET numerical code.

4.3 Vertical Groundwater Flow Analysis by FLONET

The vertical hydraulic conductivity of the aquifer at the Auto-Ion site is less than the horizontal hydraulic conductivity. This condition is derived from the geologic conditions identified during the remedial investigation.

Materials deposited by fluvial action are horizontally bedded and classically have vertical hydraulic conductivities that are one to two orders of magnitude lower than the horizontal conductivities. Since FLOWPATH is two-dimensional, the analysis of flow conditions in the horizontal plane could be assessed, however, the analysis of flow conditions in the vertical profile was assumed to be homogeneous. In order to gain an insight into the impact of reduced vertical hydraulic conductivities on anticipated flow conditions, the two-dimensional vertical profile FLONET numerical code was utilized.

The input conditions for FLONET were essentially the same as they were for the FLOWPATH analyses discussed above. Figure 14 is a north-south cross-section through the site area and identifies the parameters considered for the FLONET numerical analysis. The lower confining bed was simulated across the bottom of the model as a no flow boundary. The saturated flow thickness of the model was assumed to be 100 feet. The precipitation infiltration over the top of the model was assumed to be 10 inches a year throughout the site area, the same as the FLOWPATH analysis.

The left edge of the model boundary (Figure 14) was simulated as a constant flux boundary. This is consistent with the simulation conducted in the FLOWPATH analysis. Constant flux conditions were evaluated for both the hydraulic conductivity of 1×10^{-2} cm. per sec. and 1×10^{-3} cm. per sec.

The right hand edge of the model was considered to be a River discharge boundary. The Kalamazoo River does not completely intersect the saturated thickness of the aquifer. however, since the River basin is generally symmetrical, and it is a receiving stream, the majority, if not all of the groundwater flow from under the site area will discharge to the River.

The groundwater extraction system for the FLONET analysis was simulated as a drain tile collection system fixed at a depth slightly below the River elevation. For the purposes of the FLONET mathematical simulation, two sets of analyses were conducted. In the first set of analyses the drain tile was simulated to be one foot below the River and in the second set of analyses, three and a half feet below the River elevation.

The use of a drain tile extraction system is most appropriate for the numerical analysis using FLONET. Since the FLONET numerical code is designed for vertical cross-section (two-dimensional) analysis, the drain tile would be considered continuous over the unit width of the section. Furthermore, the groundwater flow in each adjoining section would be based on the same conditions. Thus, the impact of a shallow depth drain tile extending across the site can be assessed. This was the groundwater extraction system methodology used in the FLONET analysis.

The hanging barrier wall was simulated as an impediment to flow in the upper portion of the aquifer. Figure 15 shows the simulation and identifies the conditions analyzed. As can be seen from this figure, the flow from the Kalamazoo River induced by pumping of the remedial drain tile groundwater extraction system would have to move downward to the bottom of the barrier wall and then back upward to the collection system. The amount of drain tile flow reduction caused by the placement of the barrier wall would be a product of both the increased length of the groundwater flow path and the reduction in the vertical hydraulic conductivity as compared to the horizontal.

4.4. FLONET Numerical Analysis Results

Two sets of analyses were conducted using the FLONET model. The first set of analyses were conducted assuming a horizontal conductivity of 1×10^{-3} cm. per sec. and a vertical hydraulic conductivity of 1×10^{-4} cm. per sec. The second set of analyses were conducted using a horizontal hydraulic conductivity of 1 x 10^{-2} cm. per sec. and a vertical conductivity of 1 x 10^{-3} cm. per sec. Within each set of analyses six evaluations of groundwater flow were conducted. These various evaluations related to the depth of the groundwater drain within the Auto-Ion site area and the elevation of the bottom of the barrier wall. Table 1 presents a summary of the results of the FLONET analytical analyses.

4.4.1 Lower Hydraulic Conductivity Simulations Using FLONET

Six evaluations of groundwater conditions were conducted using the FLONET numerical code for the lower hydraulic conductivity conditions of the site area. Figures 16 to 21 show the conditions that were simulated. Each of these figures illustrates the data summarized in Table 1 for each of the numerical analyses.

The first two numerical analyses (Run #1 and #2) were conducted with no barrier wall present between the site and the River. In the first analysis, the groundwater drain was at a depth of approximately 3.5 feet below the elevation of the River. In the second analysis, this drain elevation is only a foot below the River elevation. The flow rate from the groundwater drain for these two analyses was in the range of 2.5 to 3.5 gpm.

The remaining four numerical analyses conducted under lower hydraulic conductivity conditions utilized various elevations for the drain tile system and varying elevations for the bottom of the barrier wall placed between the River and the site area. These numerical analyses are illustrated in Figures 18 to 21 and are identified in Table 1 as Run #3 to #6. All four of these numerical analyses generally indicate that the overall groundwater flow rate from the drain would be in the range of 2.5 gpm.

All six of these numerical analyses indicate that the recharge from the Kalamazoo River is not a significant factor when the aquifer hydraulic conductivity is relatively low. In addition, the results of these numerical analyses, both in terms of the flow rates and the developed conclusion are consistent with the numerical analyses conducted using the FLOWPATH numerical code for the lower hydraulic conductivity conditions.

4.4.2 Higher Hydraulic Conductivity Simulations Using FLONET

A total of six numerical analyses were also conducted considering a higher hydraulic conductivity for the aquifer material. The results of these six analyses are illustrated in Figures 22 to 27 and are listed in Table 1 as Run #7 to #12. The first two numerical simulations (Table 1, Run #7 & #8, Figures 22 & 23) were conducted for two different drain tile elevations, assuming no barrier wall between the River and the groundwater extraction system. These analyses indicated that the total groundwater flow rate to the remedial drain system would be in the range of 20 to 30 gpm.

Four additional numerical analyses were conducted for varying drain elevations and barrier wall depths. Figures 24 to 27 illustrate the conditions that were assessed. These analyses indicate that the overall groundwater flow rate to the drain under the higher hydraulic conductivity conditions would be approximately 20 gpm. Thus, it appears that groundwater drawdown in the range of 3.5 feet can be maintained with a flow rate of approximately 20 gpm if a hanging barrier wall up to 50 feet deep is placed between the site area and the River.

4.5 Comparison of Numerical Analyses to Monitored Groundwater Data

The available data indicate that the groundwater table throughout the entire site area is relatively flat. Some mounding conditions were observed during the supplemental remedial investigation in 1990, however, water table relief under these conditions did not appear to exceed one foot. In addition, groundwater measurements were taken during the remedial investigation program. The groundwater table elevation data reported for these measurements is reproduced in Table 2 of this report. Measurements were taken during 1987, 1988 and 1990. These data indicate that the maximum variance of the groundwater table in the site area was approximately 2 to 3.5 feet. Thus, a groundwater extraction system that can maintain a drawdown of 3.5 feet over the site area should be effective in controlling groundwater movement.

5.0 SENSITIVITY ANALYSES

The various numerical analyses indicate that the groundwater flow system becomes relatively insensitive to River infiltration when the aquifer hydraulic conductivity is low. When analyses were conducted with higher hydraulic conductivities, it was found that River infiltration became a significant factor with respect to the groundwater extraction system flow rate.

The numerical analyses also indicate that the drawdown of the groundwater table is a significant factor with respect to the amount of recharge derived from the Kalamazoo River. Specifically, numerical analyses Runs 7 & 8 (Table 1) show that without a barrier wall the increase in River recharge was significant when drawdown was increased from 1 foot to 3.5 feet below River elevation. The percentage of flow at the drain tile attributable to River infiltration increased from 0 percent to 25 percent with this 2.5 foot increase in drawdown. When a barrier wall was simulated in these analyses (Runs 9 to 12, Table 1), the extent of drawdown appeared to have virtually no impact on system flow rates or River recharge percentage. Thus, the barrier wall reduces the sensitivity of the groundwater extraction system to variations in flow caused by drawdown differences and River recharge.

6.0 CONCLUSIONS

The groundwater flow numerical analyses for the Auto-Ion site indicate that if the hydraulic conductivity in the site area is relatively low, on the order of 1 x 10^{-3} cm. per sec. or less, the groundwater flow beneath the site can be controlled by the installation of pumping wells or a drain tile collection system with no barrier wall between the site and the River. If, however, the aquifer hydraulic conductivity is relatively high, a significant groundwater pumping rate would be needed to control flow gradients if no barrier wall were installed. In the case of high aquifer conductivities, the installation of a barrier wall appears to have a positive effect with respect to maintaining groundwater drawdowns needed to control groundwater movement across the site.

The second conclusion derived from the numerical analyses is that the maximum flow rate anticipated for a groundwater extraction system at the Auto-Ion site would be on the order of a few tens of gallons per minute. This flow rate appears adequate to achieve the stated objective of maintaining inward groundwater flow conditions across the Auto-Ion site area. These analyses are based upon an understanding that the hydraulic conductivity of 1 x 10^{-2} cm. per sec. is representative of overall site conditions. This hydraulic conductivity would have to be verified in order to design a pumping system.

TABLE 1

Summary of FLONET Simulations
Cross-Section Modeling

Run No.	Horizontal Conductivity (cm/sec)	Vertical Conductivity (cm/sec)	Groundwater Drain Elevation	Barrier Wall Elev. (Bottom)	Groundwater Flow Pumped From Drain	% of Flux From River
1	10^{-3}	10^{-4}	751.0	N/A	3.5 gpm	16
2	10^{-3}	10^{-4}	753.5	N/A	2.4 gpm	0
3	10^{-3}	10^{-4}	751.0	731.0	2.7 gpm	0
4	10^{-3}	10^{-4}	753.5	731.0	2.2 gpm	0
5	10^{-3}	10^{-4}	751.0	706.0	2.7 gpm	0
6	10^{-3}	10^{-4}	753.5	706.0	2.4 gpm	0
7	10^{-2}	10^{-3}	751.0	N/A	30.8 gpm	25
8	10^{-2}	10^{-3}	753.5	N/A	19.6 gpm	0
9	10^{-2}	10^{-3}	751.0	731.0	22.4 gpm	0
10	10^{-2}	10^{-3}	753.5	731.0	18.2 gpm	0
11	10^{-2}	10^{-3}	751.0	706.0	22.4 gpm	0
12	10^{-2}	10^{-3}	753.5	706.0	18.2 gpm	0

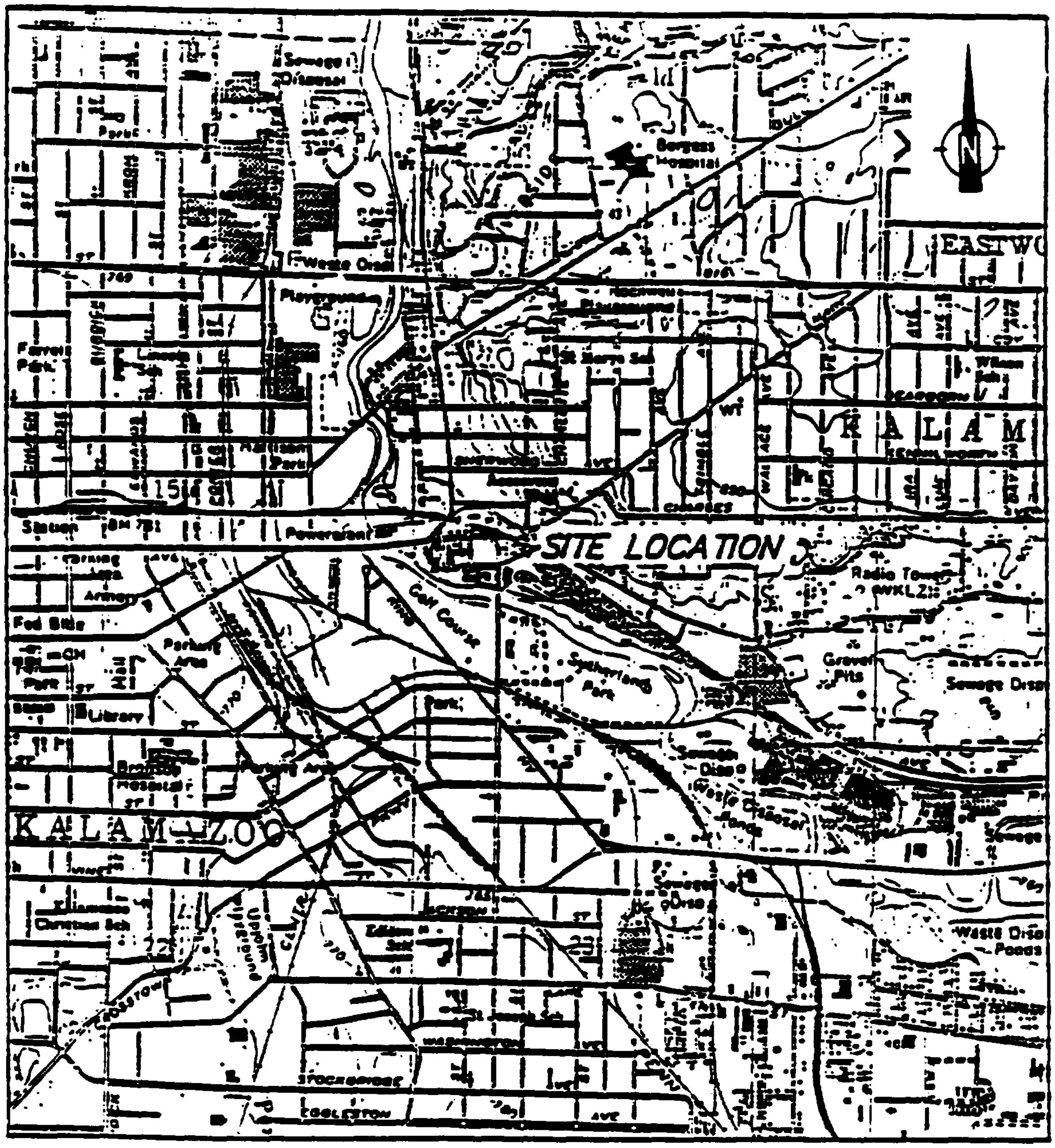
Notes: N/A means no barrier present in simulation.
River elevation simulated at 754.6 feet.
Recharge input at 10 in/yr.
Groundwater drain is 250 feet long.
Barrier hydraulic conductivity simulated at 10^{-7} cm/sec.

TABLE 2

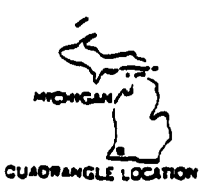
Groundwater Elevations
Auto-Ion Site
Kalamazoo, Michigan

Well No.	11/03/87	01/08/88	02/21/88	03/07/88	03/25/88	12/06/90	12/10/90
W-1	753.87	754.99	755.52	755.22	754.95	756.75	756.26
W-2	753.99	754.59	755.53	755.09	754.84	756.91	756.16
W-3a	752.49	754.55	755.51	754.99	754.81	756.84	756.06
W-3b	752.46	754.45	755.62	754.88	754.82	756.89	756.10
W-4	752.66	754.39	755.62	754.86	754.79	756.84	756.03
W-5	752.86	754.33	755.65	754.83	754.77	756.88	755.98
W-6	753.67	754.32	755.79	754.79	754.73	756.91	755.89

Datum is USGS (mean sea level)



0 2000'



U.S. Geological Survey
Kalamazoo Quadrangle
Michigan

U

figure 1

SOURCE: EDER ASSOCIATES CONSULTING ENGINEERS
APRIL 14, 1992.

SITE LOCATION MAP
AUTO ION SITE
Kalamazoo, Michigan

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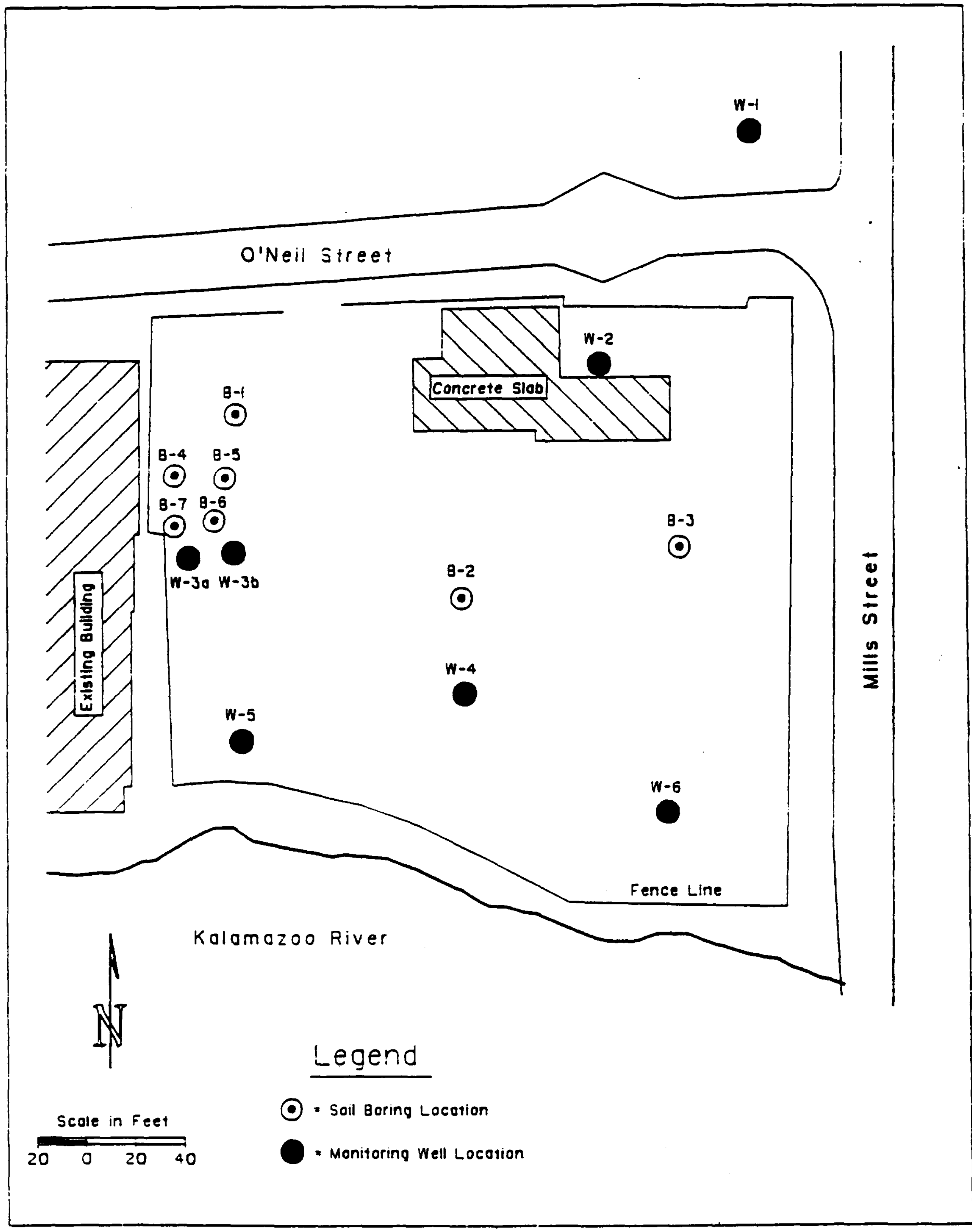


Figure 3 - Auto-Ion Site Area

Auto-Ion

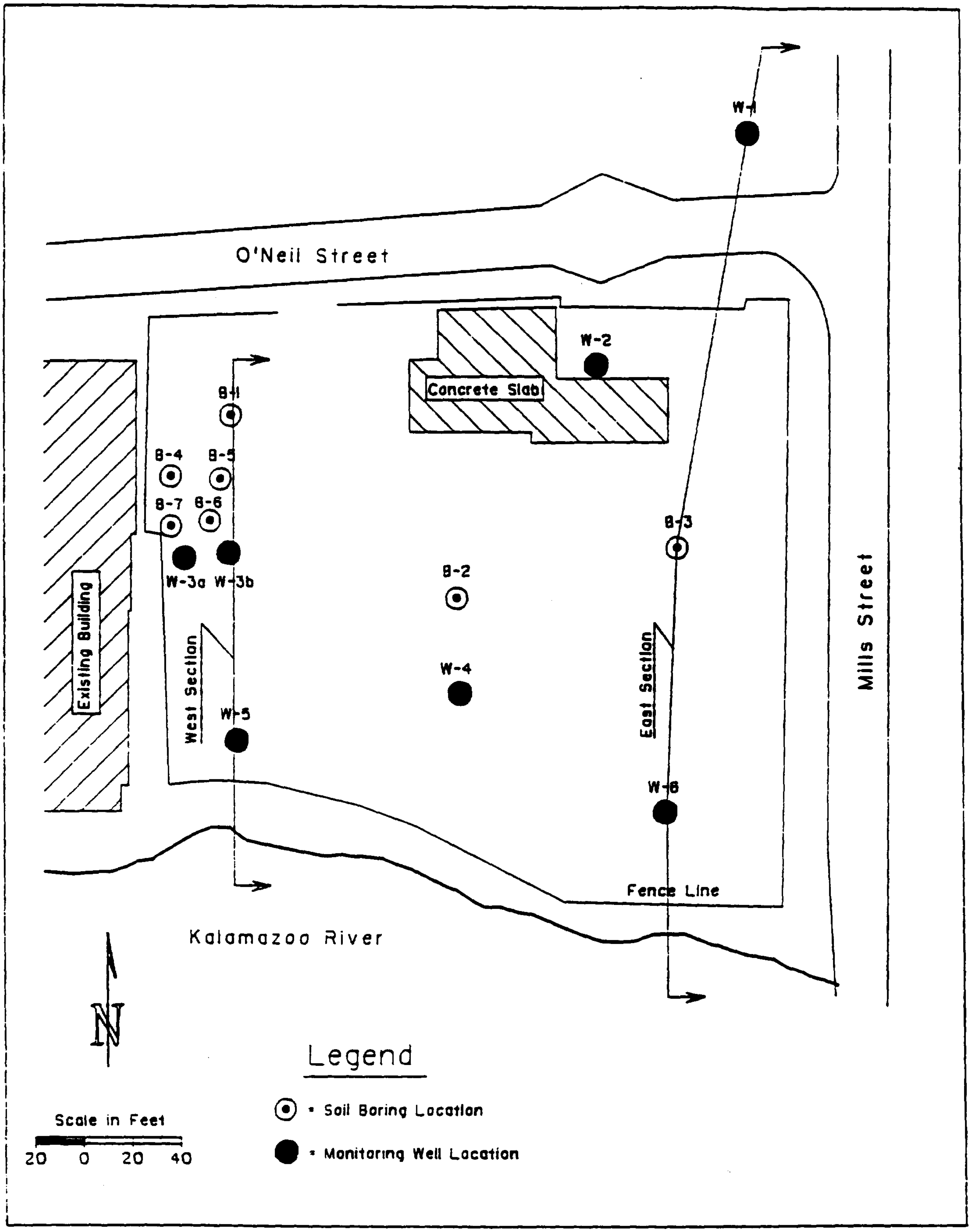


Figure 4 - Location of Cross-Sections

Auto-Ion

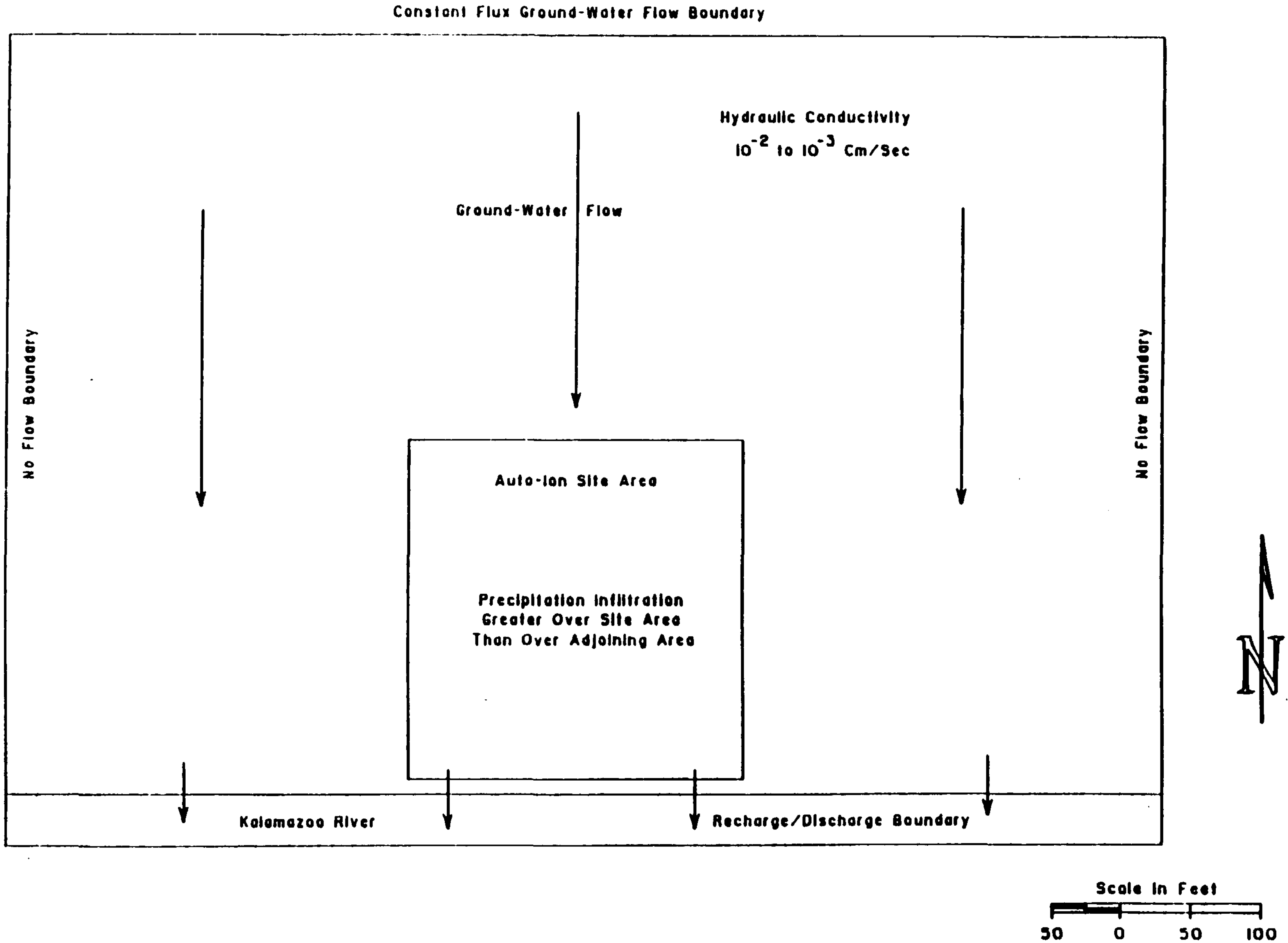


Figure 7 - FLOWPATH Boundary Conditions

Auto-Ion

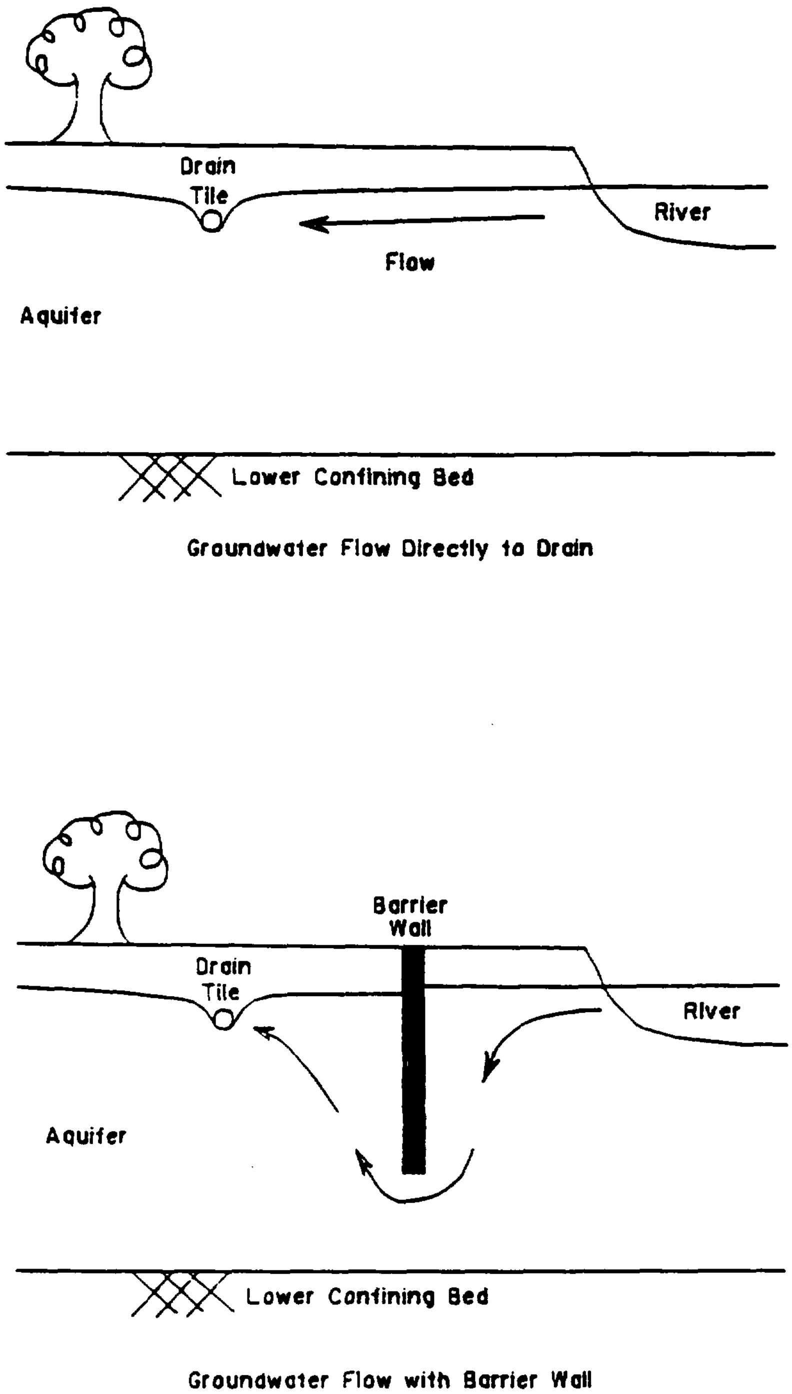


Figure 8 - Impact of Barrier Wall on Ground-Water Flow

Auto-Ion

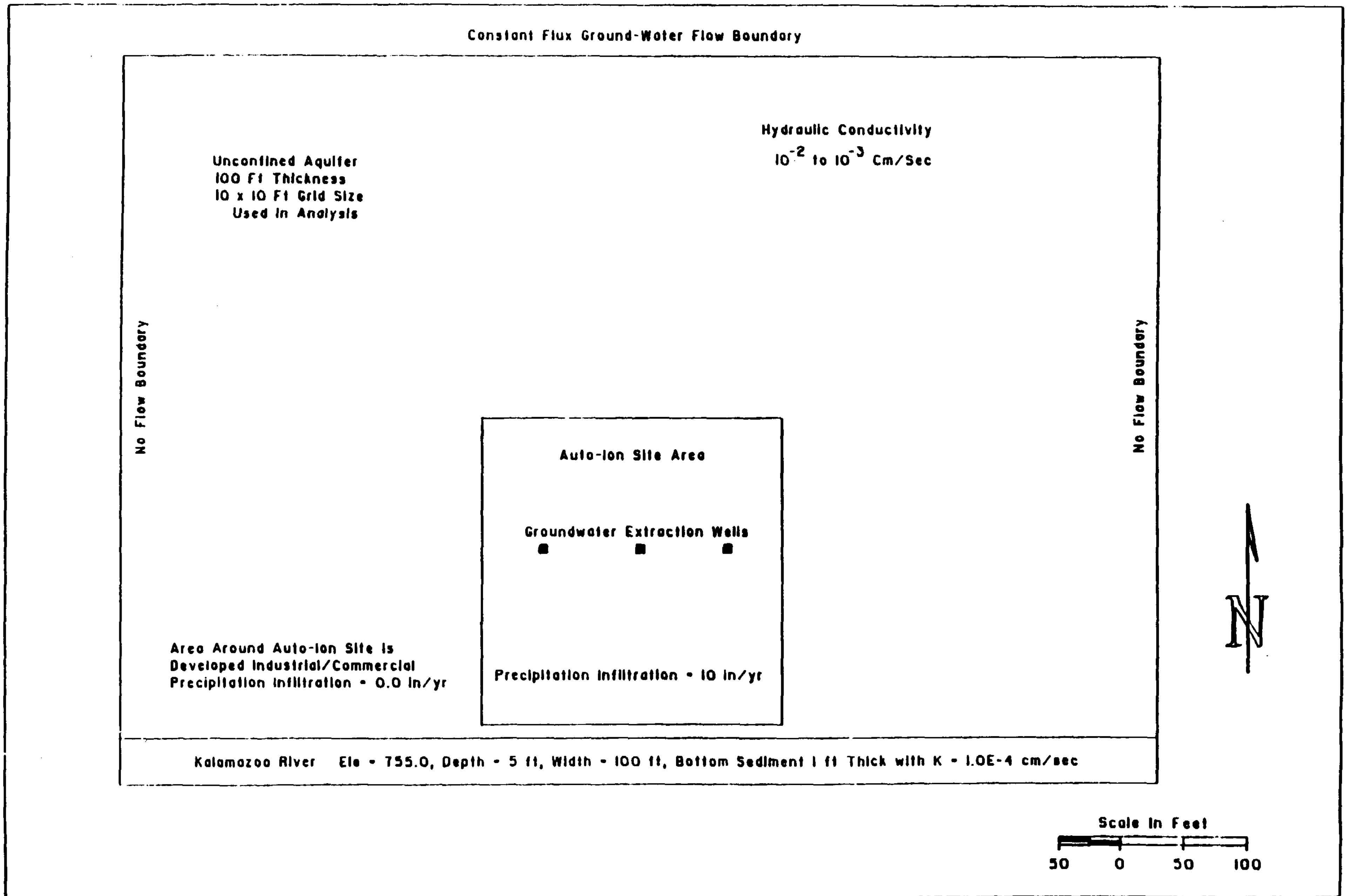


Figure 9 - Conditions Assessed with FLOWPATH

Auto-Ion

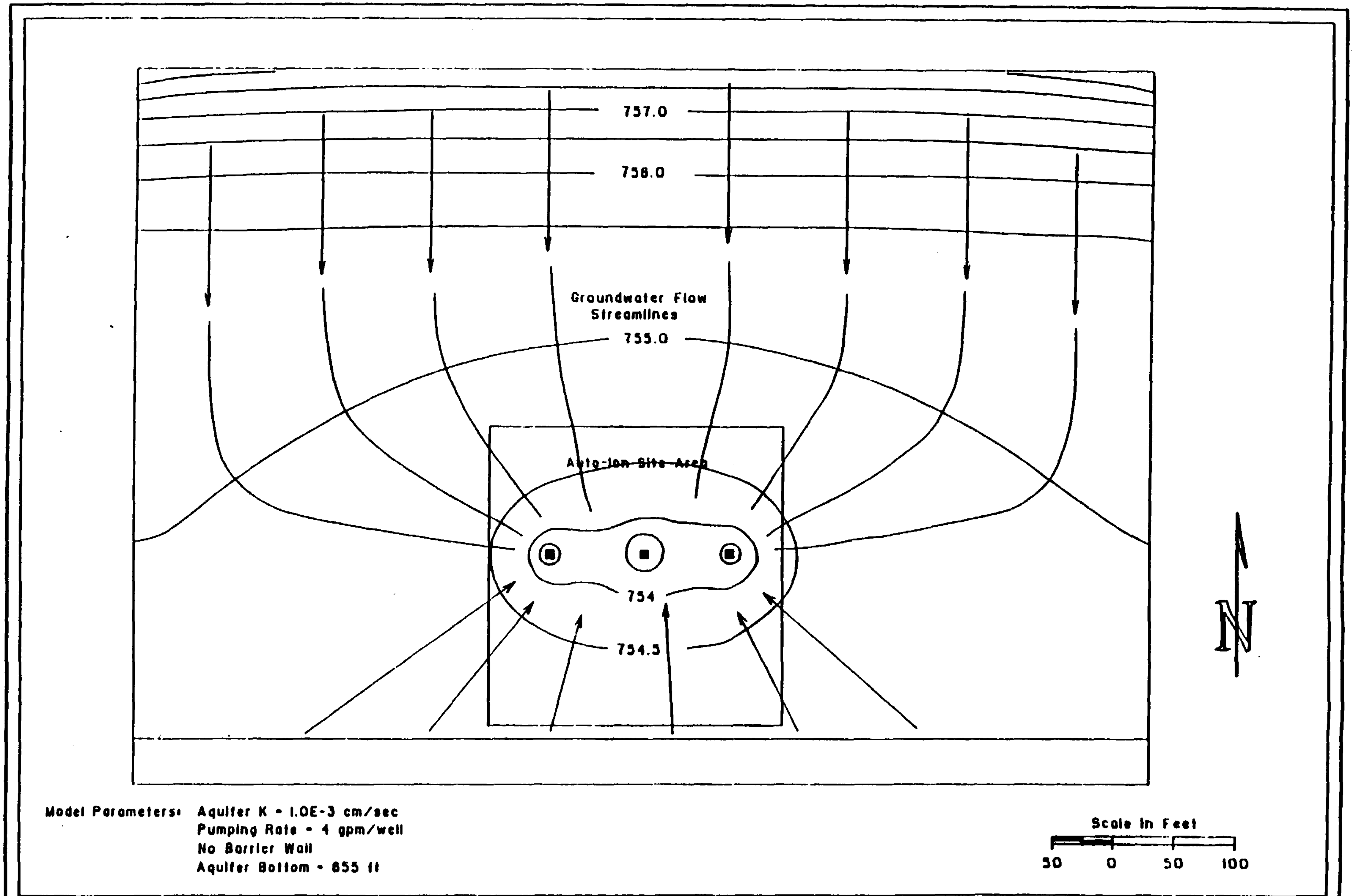
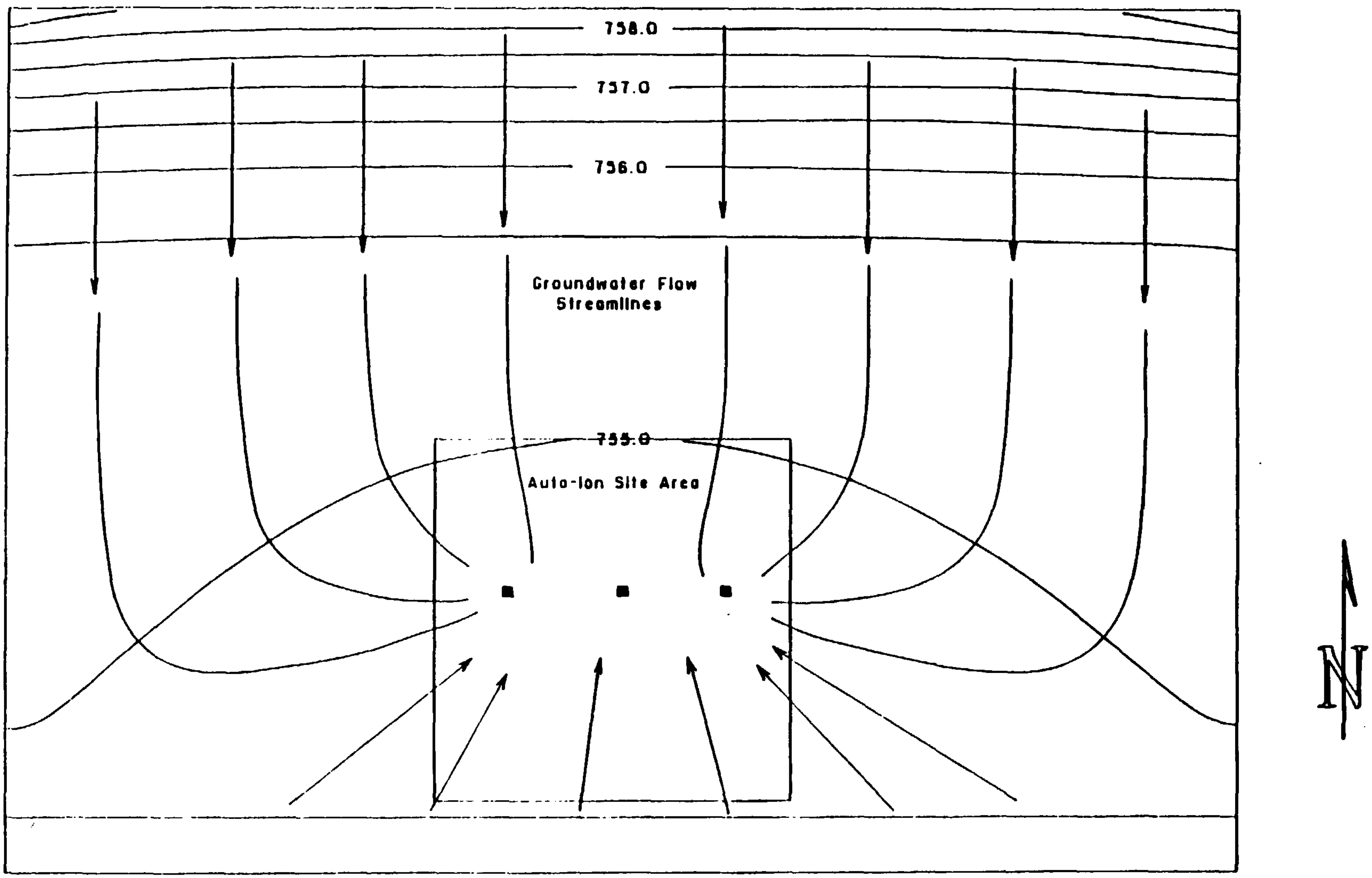


Figure 10 - Lower Permeability and Pumping Rate Model Simulation

Auto-Ion



Model Parameters: Aquifer K = 1.0E-2 cm/sec
Pumping Rate = 4 gpm/well
No Barrier Wall
Aquifer Bottom = 655 ft

Scale in Feet
50 0 50 100

Figure II - Higher Permeability and Lower Pumping Rate Model Simulation

Auto-Ion

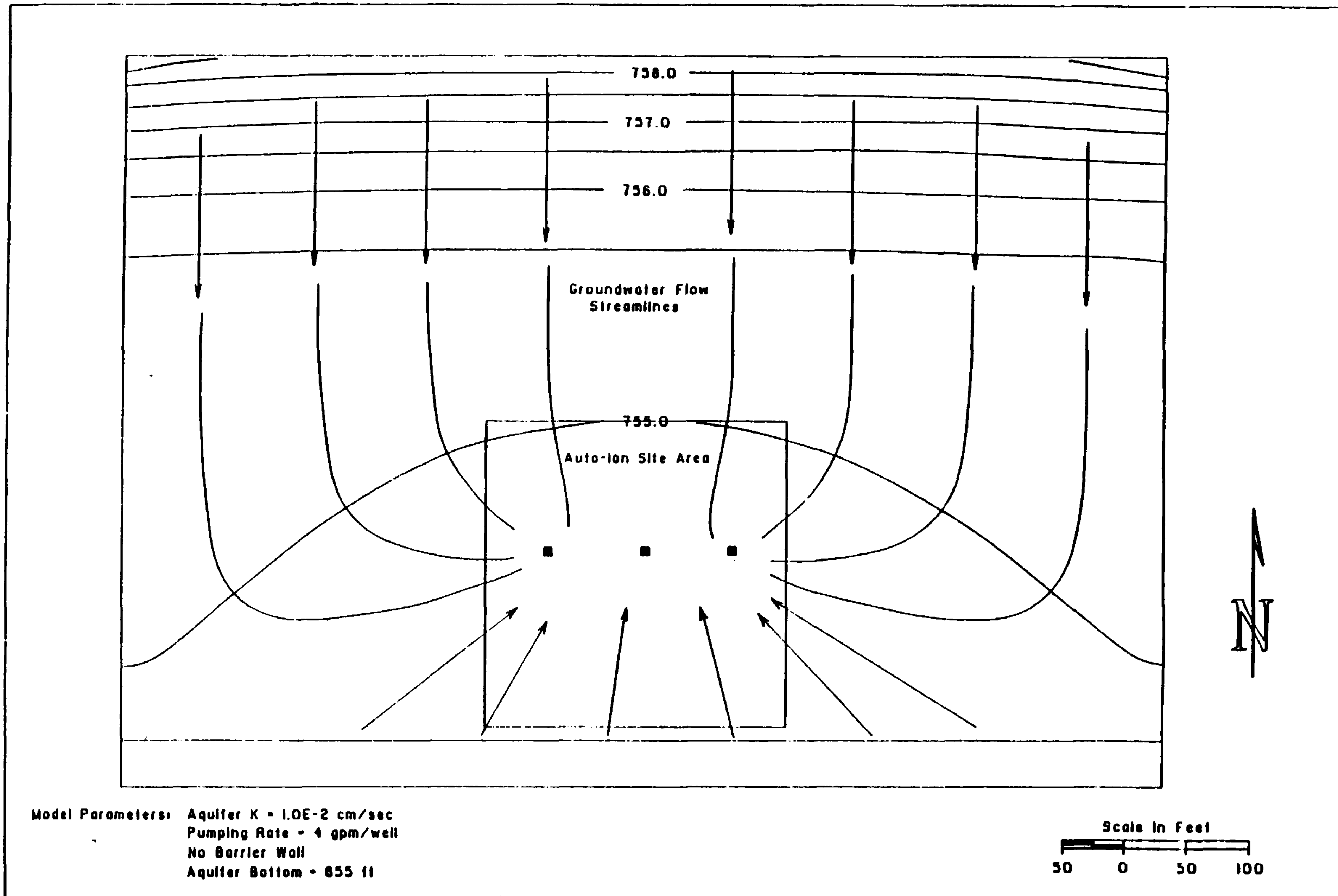


Figure 11 – Higher Permeability and Lower Pumping Rate Model Simulation

Auto-Ion

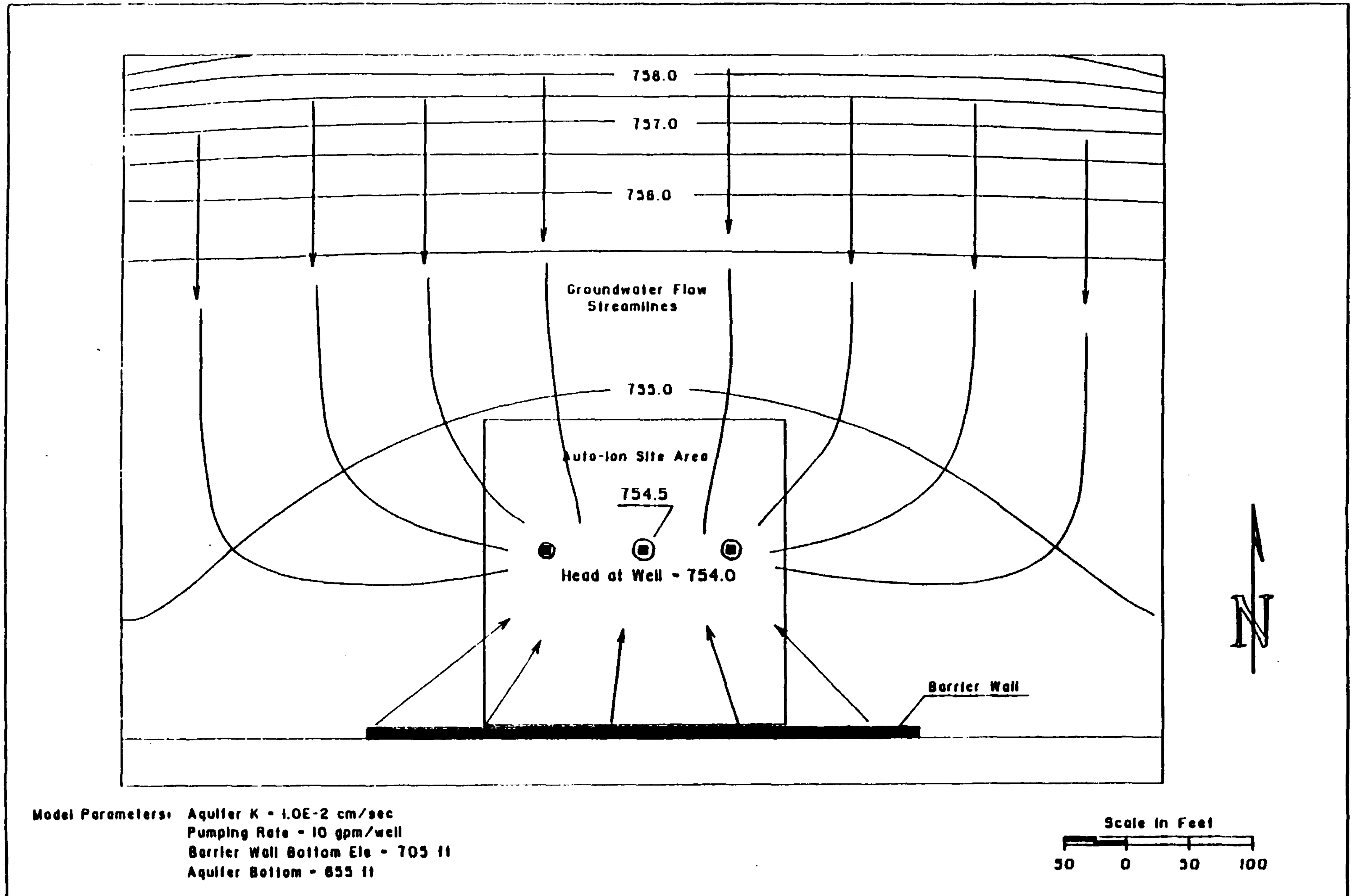


Figure 13 - Higher Permeability and Pumping Rate with Barrier Wall Model Simulation

Auto-Ion

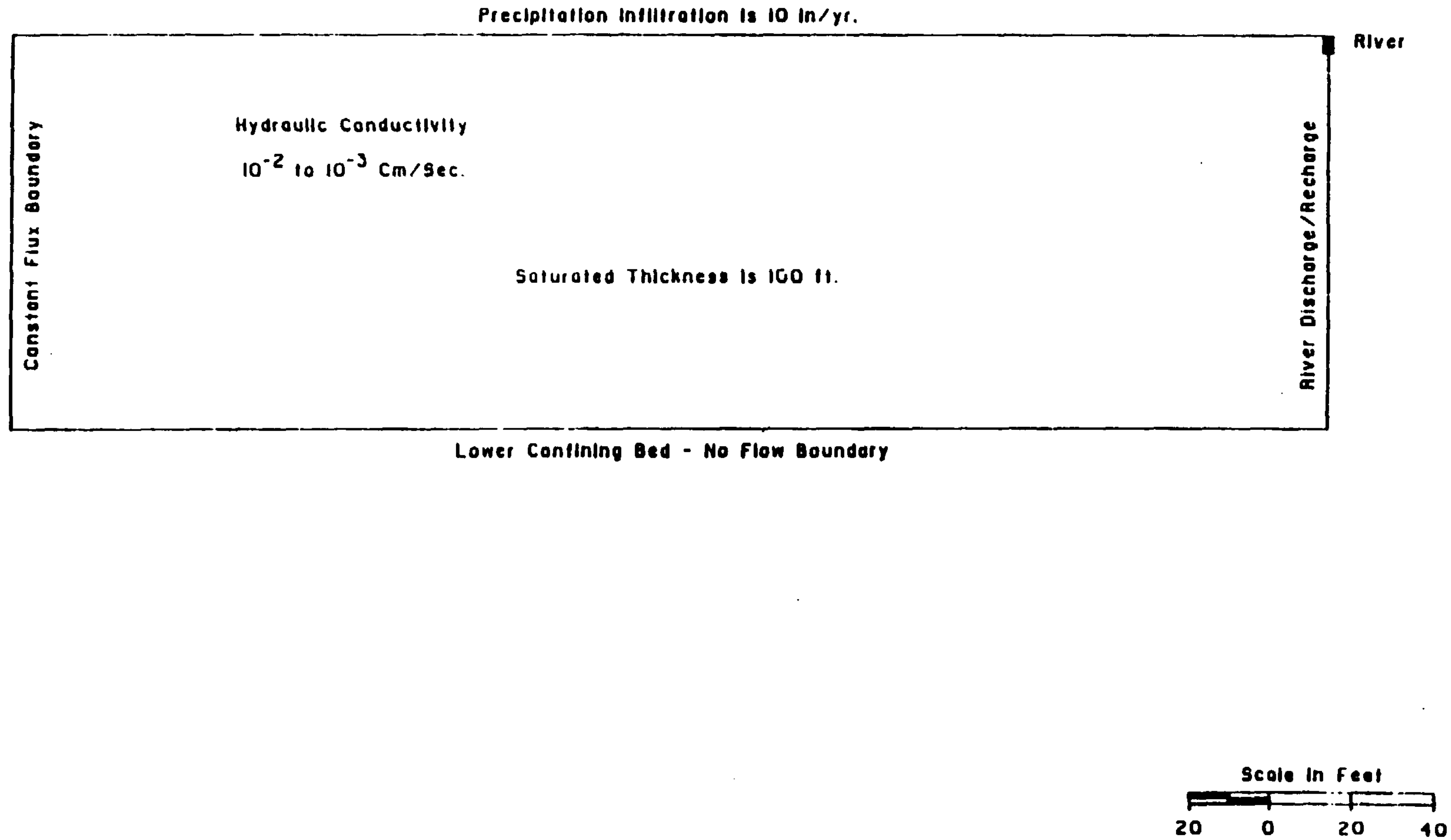


Figure 14 - FLONET Numerical Analysis
Boundary Conditions

Auto-Ion

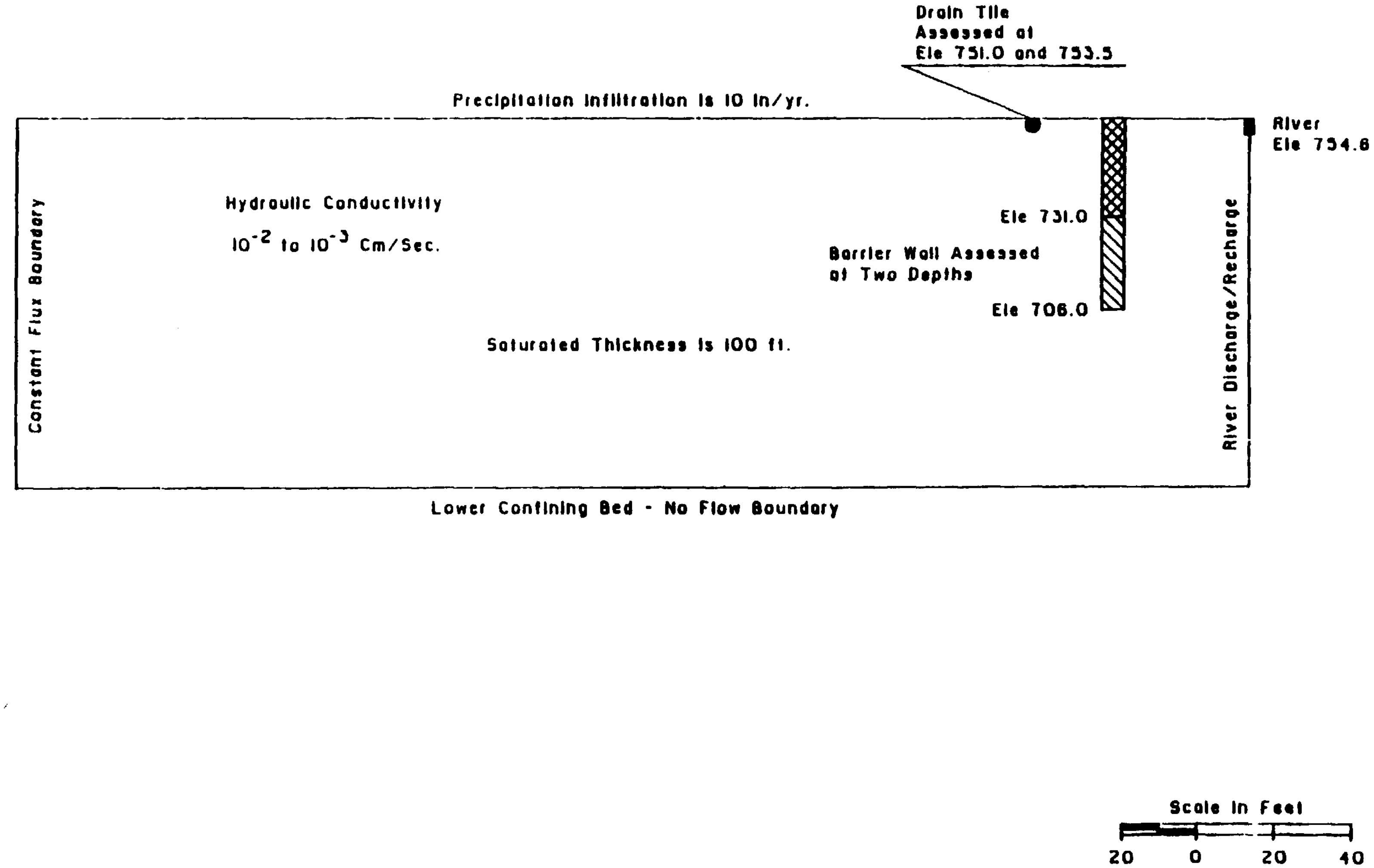
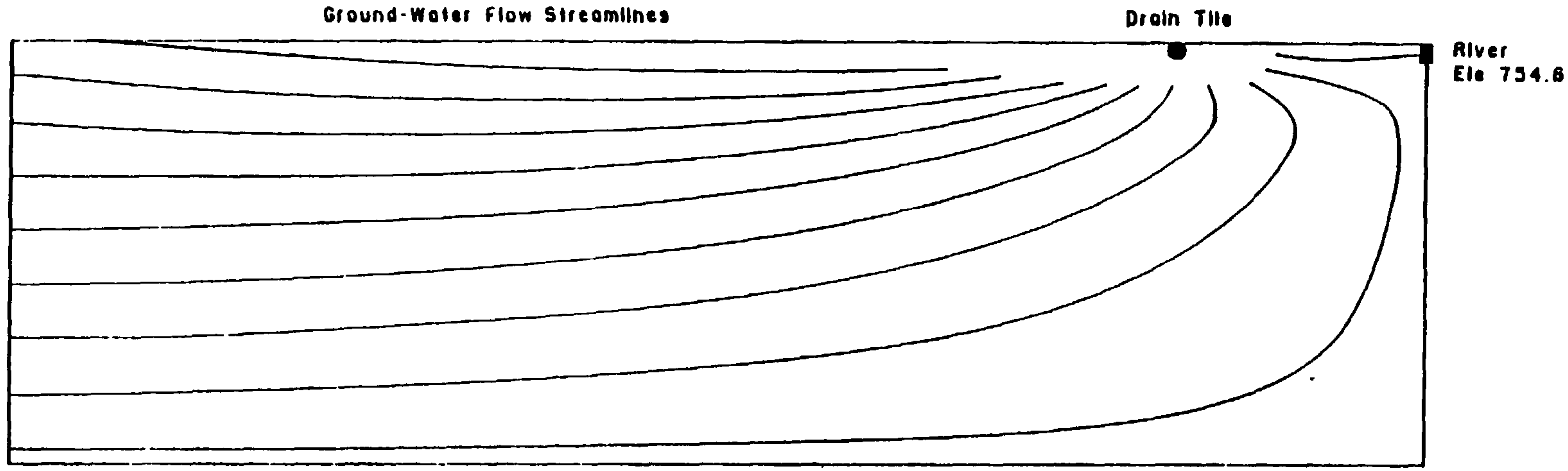


Figure 15 - Barrier and Drain Conditions Used in FLONET Analysis

Auto-Ion



Left Boundary Flux = 72 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-3 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-4 Cm/sec
Drain Tile Elevation = 751.0 Ft
Bottom of Barrier Wall Elevation = N/A

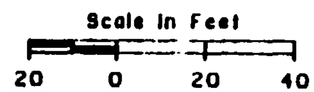
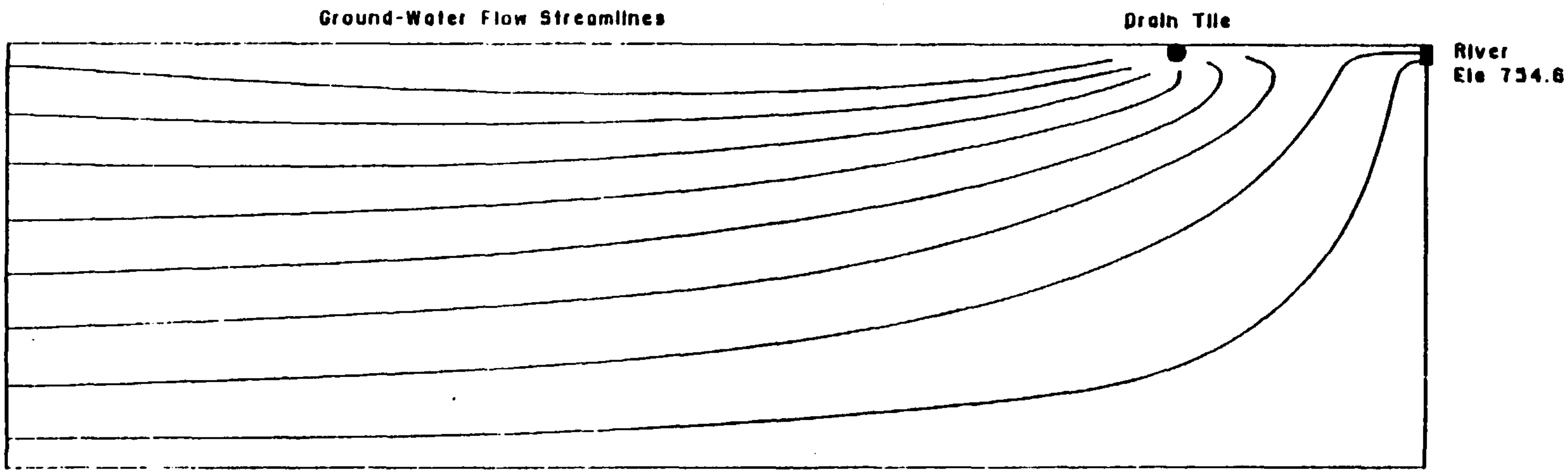


Figure 16 - FLONET Analysis No. 1

Auto-Ion



Left Boundary Flux = 72 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-3 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-4 Cm/sec
Drain Tile Elevation = 733.5 Ft
Bottom of Barrier Wall Elevation = N/A

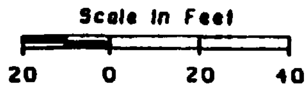
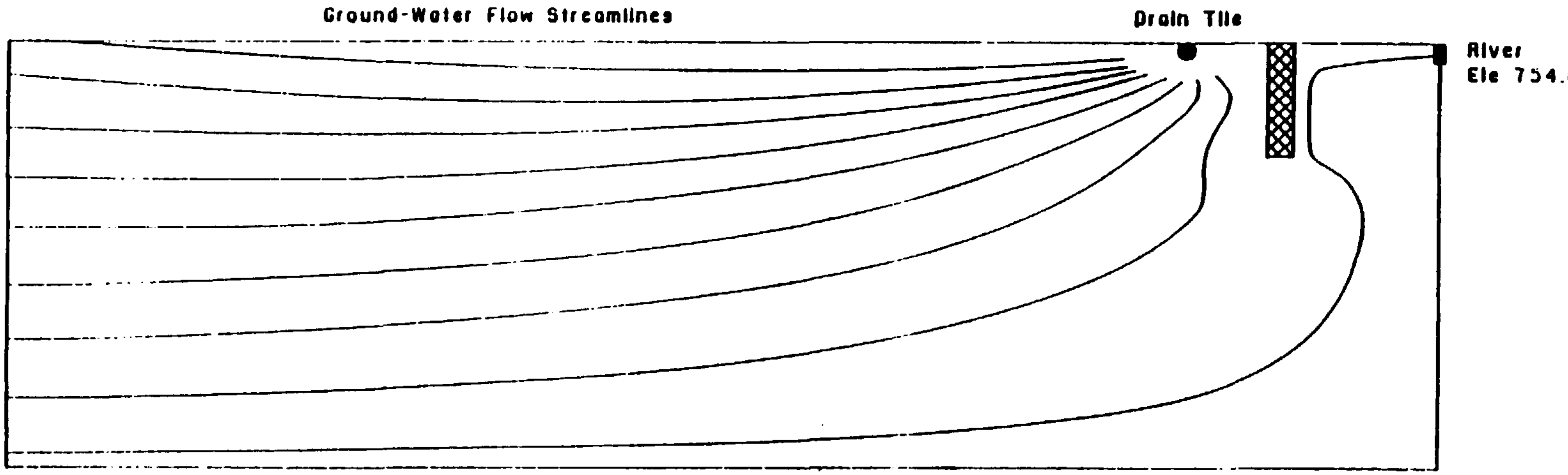


Figure 17 - FLONET Analysis No. 2

Auto-Ion



Left Boundary Flux = 72 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-3 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-4 Cm/sec
Drain Tile Elevation = 751.0 Ft
Bottom of Barrier Wall Elevation = 731.0

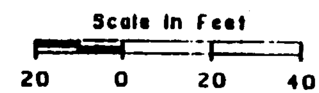
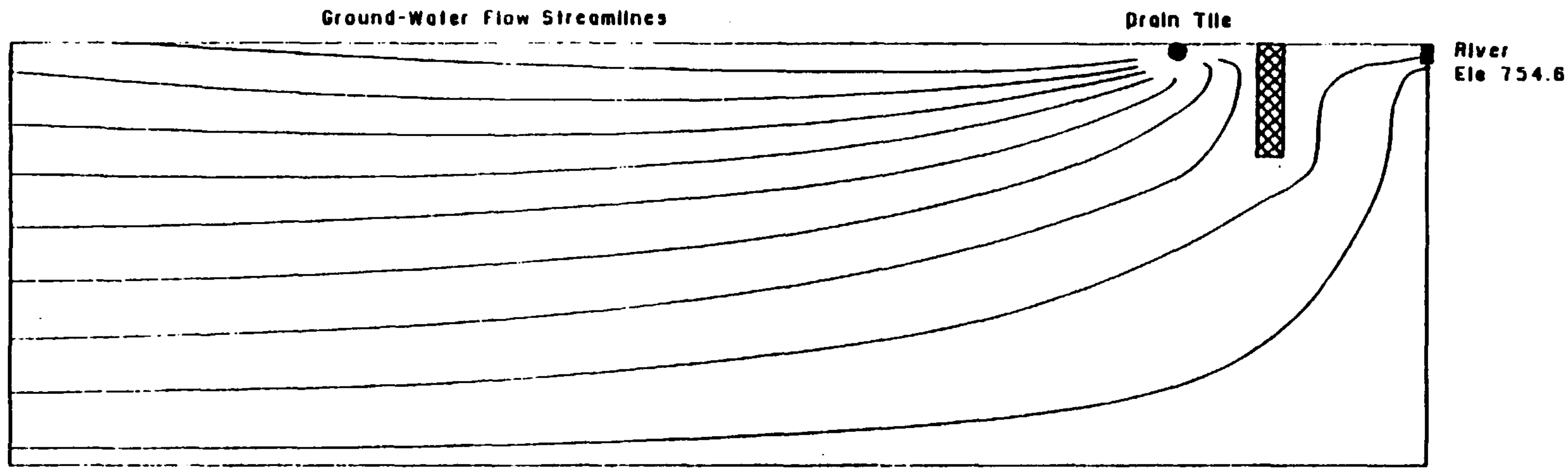


Figure 18 - FLONET Analysis No. 3

Auto-Ion



Left Boundary Flux = 72 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-3 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-4 Cm/sec
Drain Tile Elevation = 753.5 Ft
Bottom of Barrier Wall Elevation = 731.0

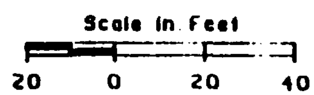
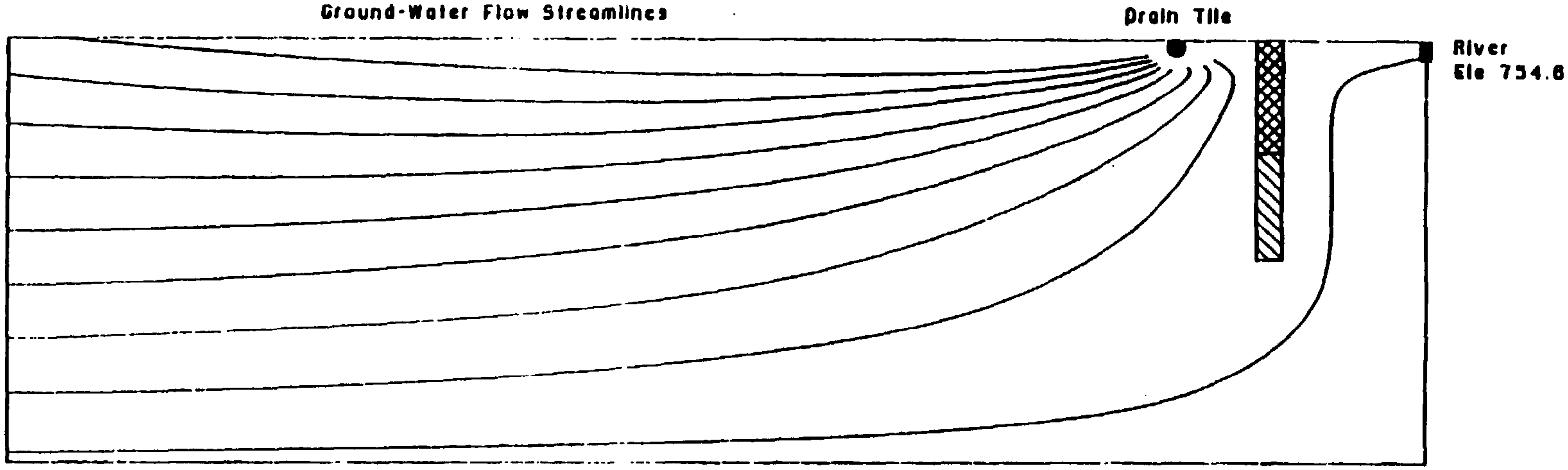


Figure 19 - FLONET Analysis No. 4

Auto-Ion



Left Boundary Flux = 72 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-3 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-4 Cm/sec
Drain Tile Elevation = 751.0 Ft
Bottom of Barrier Wall Elevation = 706.0

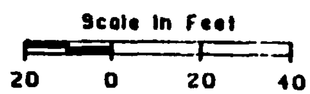
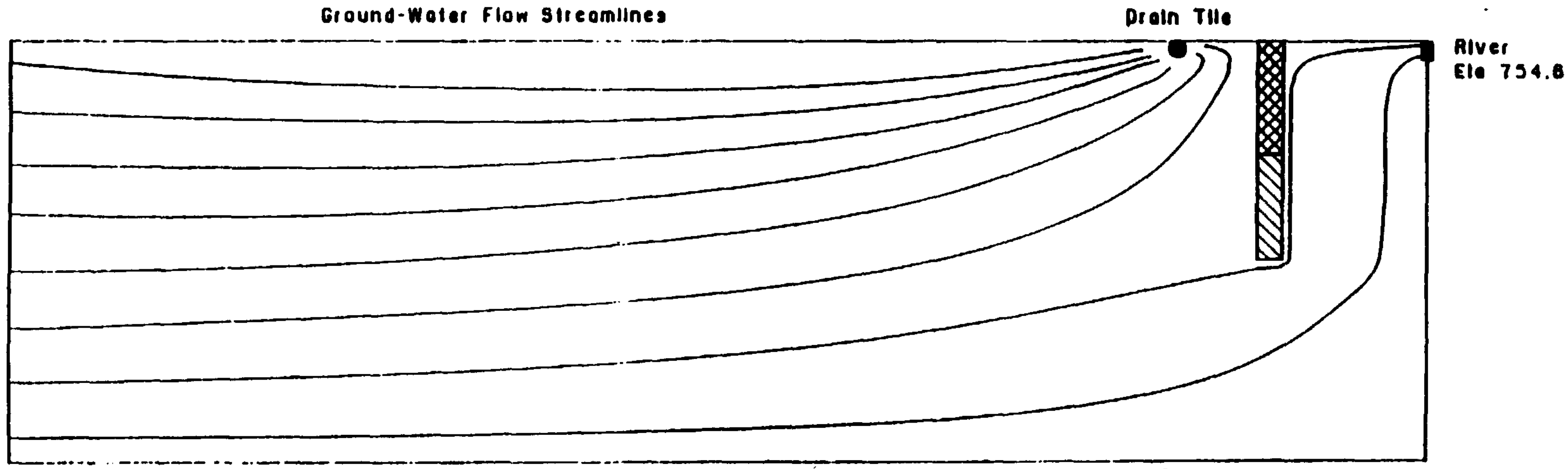


Figure 20 - FLONET Analysis No. 5

Auto-Ion



Left Boundary Flux = 72 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-3 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-4 Cm/sec
Drain Tile Elevation = 753.5 Ft
Bottom of Barrier Wall Elevation = 706.0

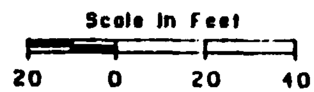
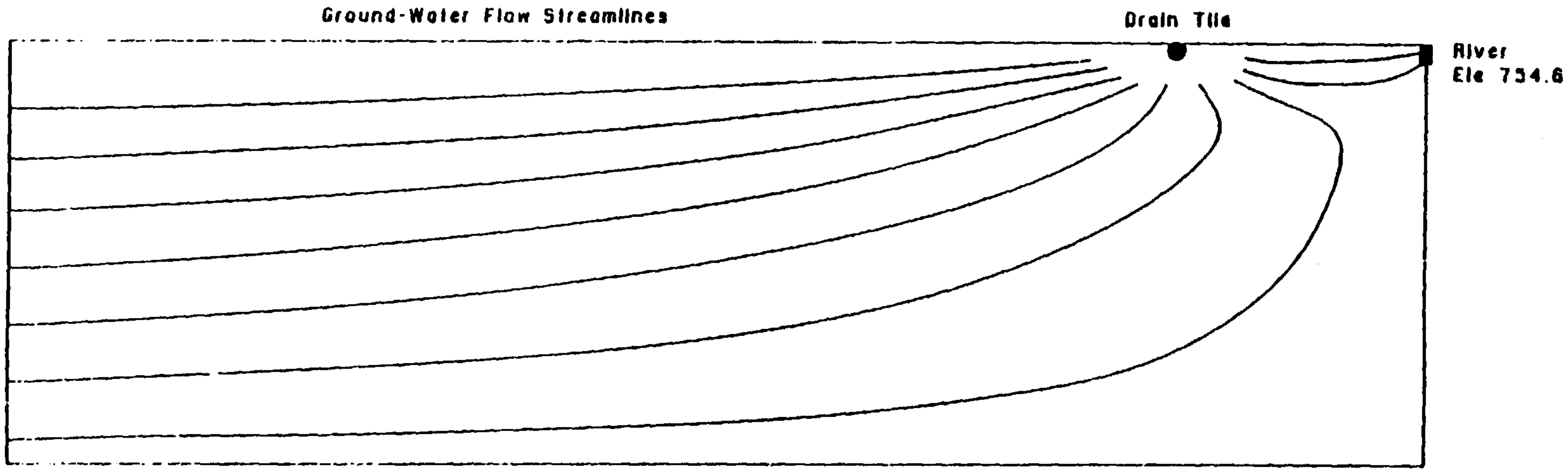


Figure 21 - FLONET Analysis No. 6

Auto-Ion



Left Boundary Flux = 720 In/yr
Precipitation Infiltration = 10 In/yr
Horizontal Hydraulic Conductivity = 1.0E-2 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-3 Cm/sec
Drain Tile Elevation = 751.0 Ft
Bottom of Barrier Wall Elevation = N/A

Scale in Feet
20 0 20 40

Figure 22 - FLONET Analysis No. 7

Auto-Ion

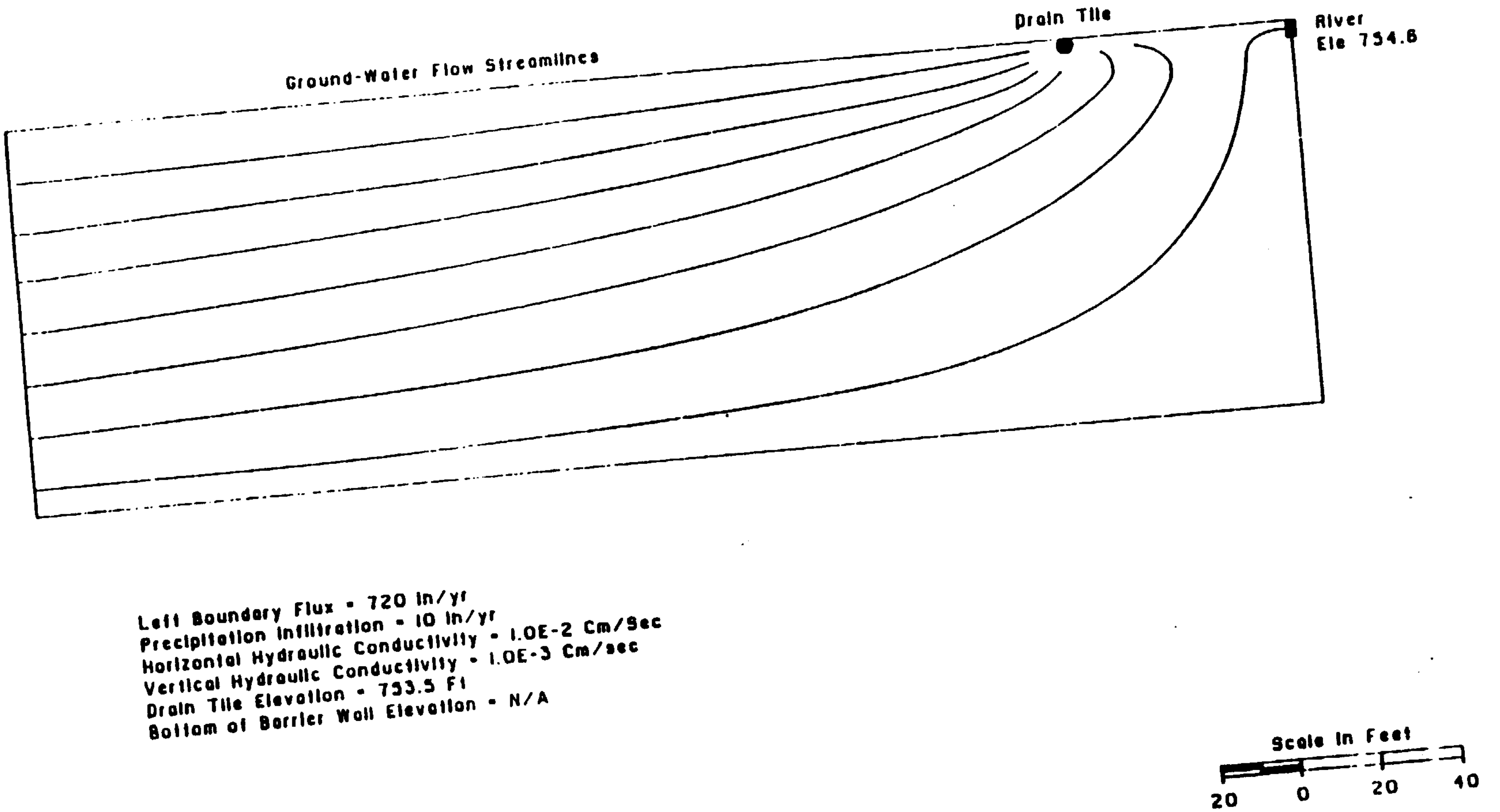
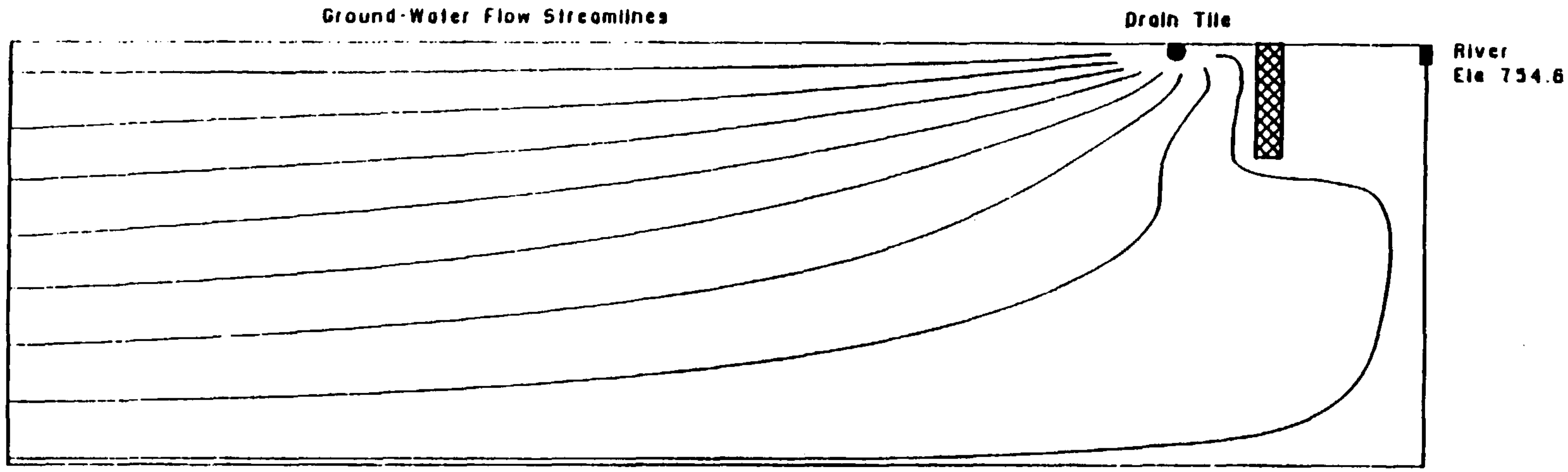


Figure 23 - FLONET Analysis No. 8

Auto-Ion



Left Boundary Flux = 720 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-2 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-3 Cm/sec
Drain Tile Elevation = 751.0 Ft
Bottom of Barrier Wall Elevation = 731.0

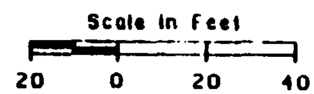
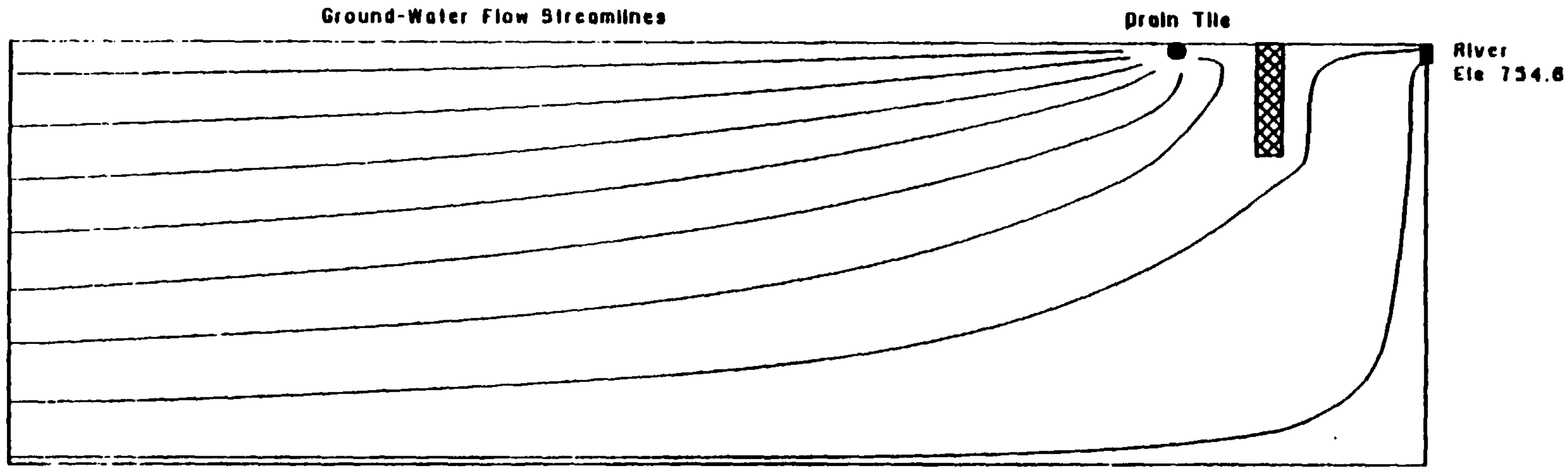


Figure 24 - FLONET Analysis No. 9

Auto-Ion



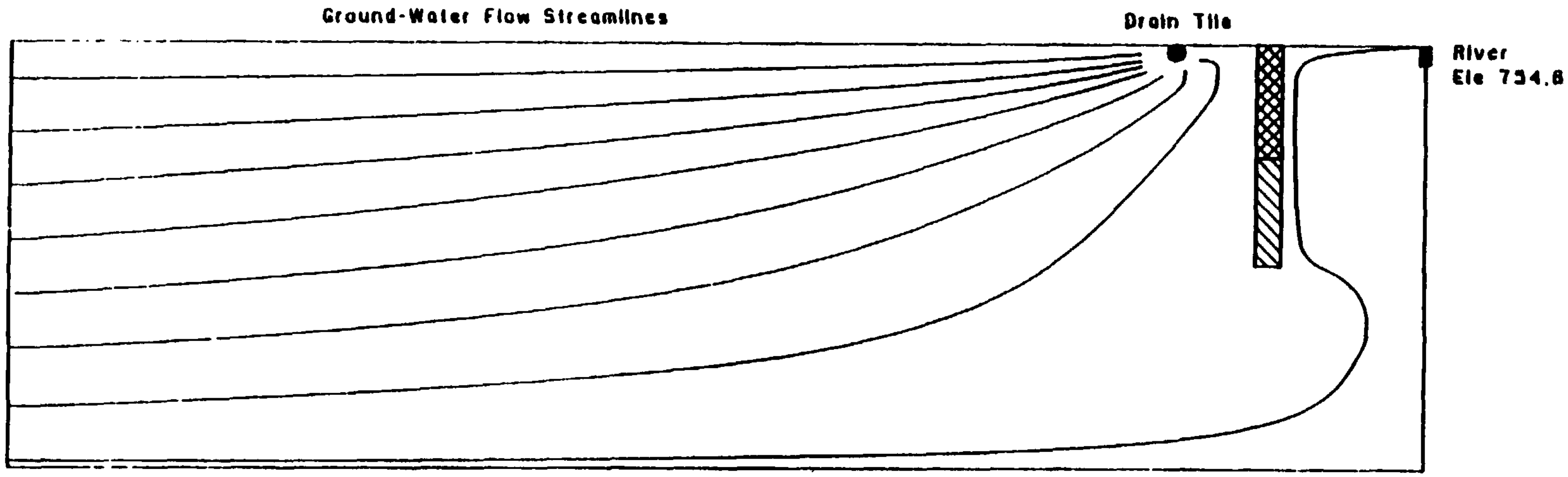
Left Boundary Flux = 720 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-2 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-3 Cm/sec
Drain Tile Elevation = 753.5 Ft
Bottom of Barrier Wall Elevation = 731.0

Scale in Feet

20 0 20 40

Figure 25 - FLONET Analysis No. 10

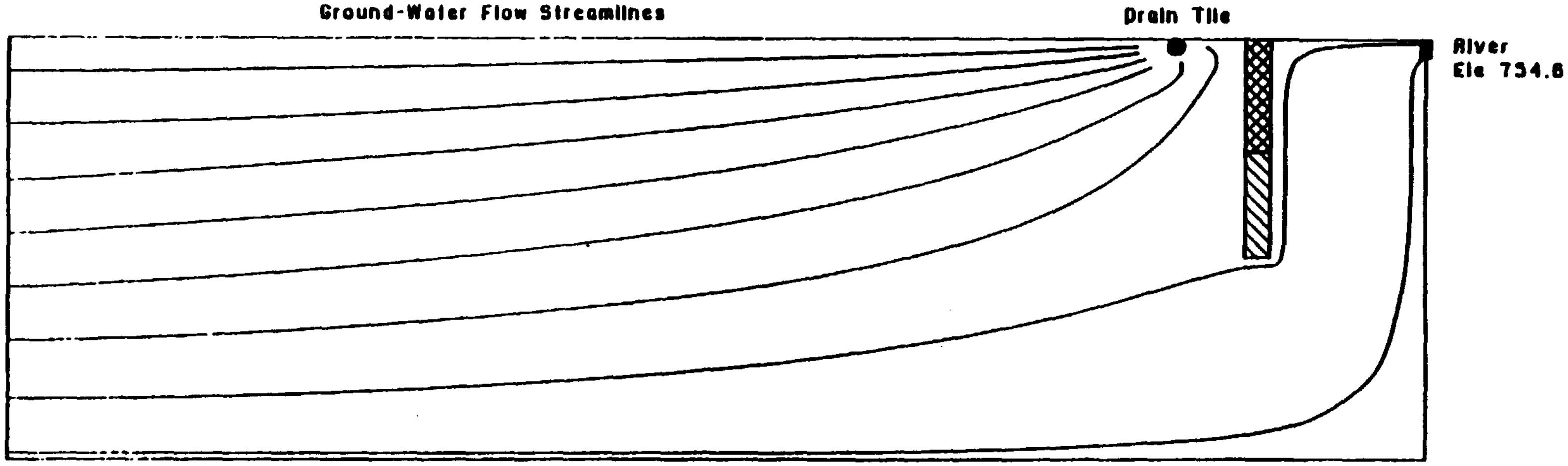
Auto-Ion



Left Boundary Flux = 720 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-2 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-3 Cm/sec
Drain Tile Elevation = 751.0 Ft
Bottom of Barrier Wall Elevation = 706.0

Figure 26 - FLONET Analysis No. 11

Auto-Ion



Left Boundary Flux = 720 in/yr
Precipitation Infiltration = 10 in/yr
Horizontal Hydraulic Conductivity = 1.0E-2 Cm/Sec
Vertical Hydraulic Conductivity = 1.0E-3 Cm/sec
Drain Tile Elevation = 733.5 Ft
Bottom of Barrier Wall Elevation = 706.0

Figure 27 - FLONET Analysis No. 12

Auto-Ion

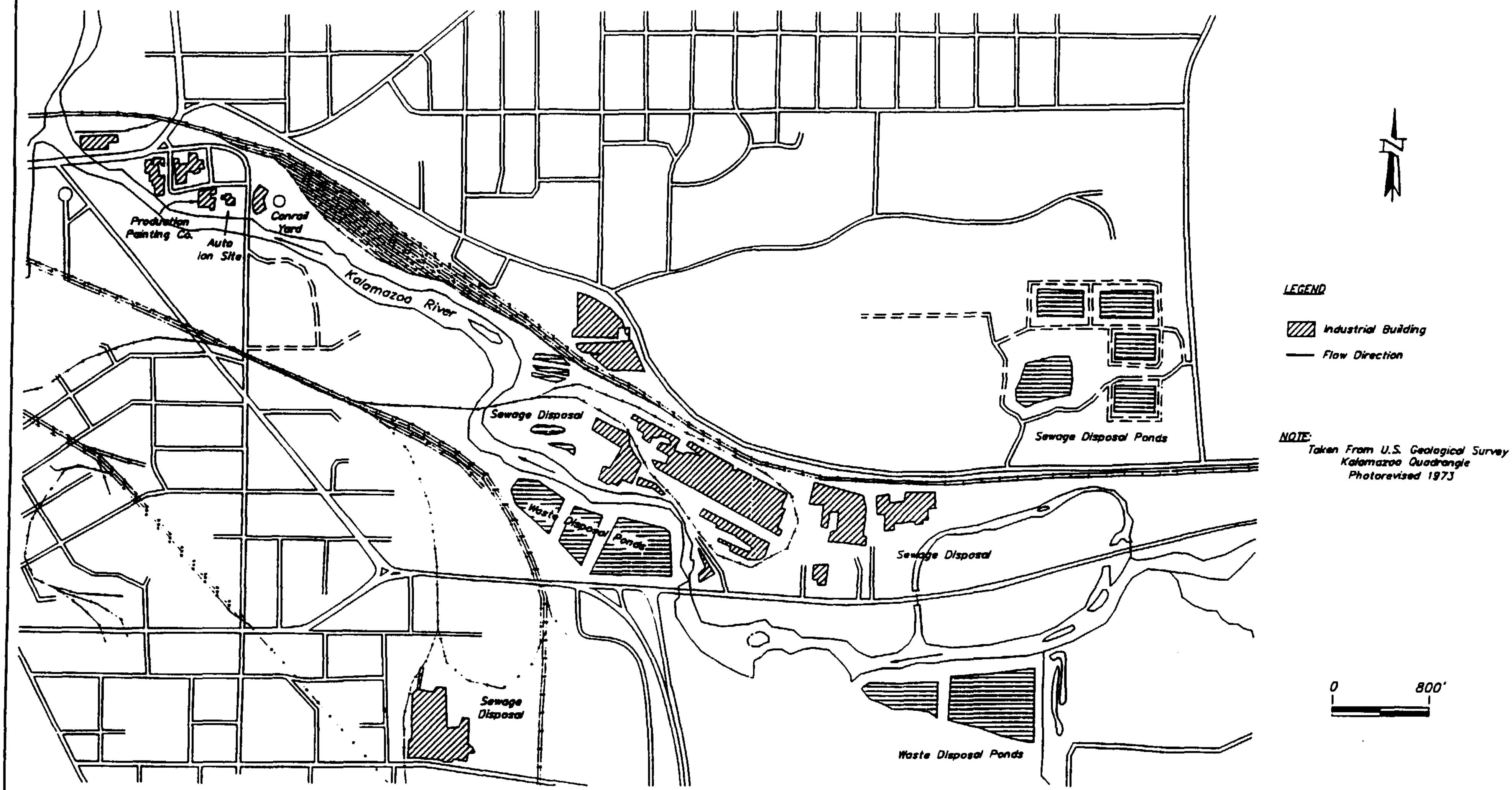


figure 2
AUTO ION AREA MAP
AUTO ION SITE
Kalamazoo, Michigan

SOURCE: EDER ASSOCIATES CONSULTING ENGINEERS
APRIL 14, 1992.

CRA

4321(2)-JUN.1/92-REV.0

APPENDIX J

TYPE C CLEANUP JUSTIFICATION FOR ALTERNATIVE 1

TYPE C CLEANUP JUSTIFICATION FOR ALTERNATIVE 1 (NO FURTHER ACTION)

In order to obtain approval for Michigan Act 307, Type C cleanup criteria, a proposal must be submitted to the MDNR which addresses all of the factors to be considered under Rule 5717. The proposed Type C criteria must be based on a site specific risk assessment which takes site conditions into account.

This proposal documents the site specific conditions at the Auto Ion site which meet the Michigan Act 307 Type C cleanup criteria for the No Further Action Alternative for groundwater.

This remedial action alternative is limited to groundwater at the site. The unsaturated soil (source control) remedial action has already been addressed by Operable Unit I. Operable Unit I involves the excavation and off-site disposal of several thousand yards of contaminated soils at the site. Operable Unit I will eliminate the only remaining source of groundwater contamination from the Auto Ion site.

<u>R 299.5717.2 Type C criteria shall be developed on the basis of a site-specific risk assessment, taking into account the following factors:</u>

<u>(a) The party who proposes the Type C remedial action shall demonstrate that the proposed criteria are appropriate for the site being considered.</u>

A site specific risk assessment was completed for this site as part of the Remedial Investigation (RI) and is contained in the 1989 Endangerment Assessment Report prepared by Fred C. Hart Associates. This risk assessment has been supplemented by the Baseline Risk Assessment for groundwater contained in Section 1.2.6 and groundwater Appendices F and I of this Feasibility Study (FS) report. The conceptual description of the proposed remedial action plan for this alternative is described in Section 7.4.1 of this FS. All Type C criteria are met for this alternative as specified in this document.

(b) Type C criteria shall take into account reasonably foreseeable uses of the site and natural resources in question.

As discussed in Section 1.2.6.1 of this FS, drinking water is not a reasonably foreseeable use for groundwater at this site. The impacted groundwater discharges into the Kalamazoo River. However, as discussed in Section 1.2.6.2, groundwater concentrations which discharge into the Kalamazoo River are too low to have any measurable impact on the river. The surface water concentration increase from these constituents is two or more orders of magnitude below surface water quality standard guidelines under Michigan Rule 57(2). These guidelines are designed to protect surface water use from wastewater discharges into surface waters. The CERCLA Baseline Risk Assessment did not identify any significant adverse impacts from the current groundwater concentrations discharging to the river. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. This alternative would not be expected to restrict any reasonable foreseeable use of the site and natural resources.

(c) Type C remedial actions shall take into account cost effectiveness.

The cost effectiveness of this alternative have been evaluated in Sections 7 and 8 of this FS. This alternative has no cost where whereas the Type B alternative is estimated to cost $7,070,000. Both alternatives are protective of human health and the environment in as much as no receptor is being adversely impacted by groundwater at the site. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. Therefore, this alternative is more cost effective than the Type B alternative.

R 299.5717.3 The party who proposes a Type C remedial action shall provide information about, and the department shall consider, all of the following factors as appropriate to the site in question:

(a) Potential exposure of human and natural resource targets.

The Baseline Risk Assessment in Section 1.2.6 of this FS evaluates potential exposure of human and natural resource targets. The Baseline Risk Assessment did not identify any adversely impacted receptor targets. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. The future use of impacted groundwater as a water source was determined to be extremely unlikely and restricted by institutional controls. The impacted groundwater concentrations which discharge to the Kalamazoo River were determined to have no significant impact in the Baseline Risk Assessment. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. Due to the extremely limited flow of the groundwater into the river, compared to the large river flow, it appears that any mixing zone, where biota may be potentially impacted, would be extremely small (see Section 1.2.6.2.6 of FS).

(b) Environmental media affected by contamination.

Three types of environmental media have been identified as being affected by the groundwater: groundwater, surface water, and river sediments. The Baseline Risk Assessment in Section 1.2.6 of this FS determined that no adverse impact would occur to the river by groundwater at the concentrations evaluated. As concluded in the March 1993

Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. The sediments appear to have been impacted from previous conditions and/or upstream sources, rather than current site conditions.

(c) All of the following with respect to the physical setting of the site.

(i) Geology

The site geology is described in detail in Section 4.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site geological information is contained in Section 1.2.5 of this FS. The impacted groundwater is located in a sand gravel unit which is very permeable. The sand contains silt and clay which retard the movement of constituents in the groundwater. It appears that the desorption of constituents from these materials is the controlling factor which will determine the time required for improvement of the groundwater quality. This geology should allow the groundwater constituents to be readily flushed out over time under natural conditions.

(ii) Hydrology

The site hydrology is described in detail in Section 4.3 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site hydrological information is contained in Sections 1.2.5 and 1.2.6 of this FS. The Kalamazoo River maintains a large volume of flow at this location which provides an ample dilution factor for the impacted groundwater discharging to it, even under low flow conditions (see Baseline Risk Assessment). As discussed in Section 1.2.6.2.6, the flow of the river is so much greater than the groundwater flow that any mixing zone present would be extremely small.

(iii) Soils

Soils at this site are being remediated under Operable Unit I as previously described. Detailed information concerning site soils is contained in the 1988 Remedial Investigation Report by Fred C. Hart Associates, the 1988 Operable Unit I Feasibility Study Report by Fred C. Hart Associates and the 1991 Operable Unit I Remedial Design/Remedial Action Workplan by Eder Associates Consulting Engineers. The implementation of the Operable Unit I Remedial Action will eliminate the only remaining source of groundwater contamination from previous operations at the Auto Ion site.

(iv) Hydrogeology

The site hydrogeology is described in detail in Section 4.4 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site hydrogeological information is contained in Sections 1.2.5, 1.2.6, Appendix F and Appendix I of this FS. Groundwater discharge from the site into the adjacent river. There are no downgradient groundwater receptors other than the river.

(v) Other aspects of the physical setting which have a bearing on the appropriateness of the proposed plan.

Information which discusses the industrial setting and surrounding property use at the site, which is relevant to the proposed remedial alternative, is contained in Section 1.2 of this FS. This is an industrial/urbanized area where water is supplied by a municipal system. Groundwater contamination has been identified on adjacent properties, the impact of these on the Auto Ion site are unknown.

(d) Background groundwater, surface water, and air quality at the site.

Background groundwater data is contained in Sections 3.4 and 5.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Sections 1.2.1 and 1.2.4 of this FS. The potential for off-site background groundwater contamination migrating onto the Auto Ion site could prevent the groundwater from ever achieving Type B cleanup criteria under any remedial alternative.

Background surface water data is contained in Sections 3.7.3.1 and 5.3 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Sections 1.2.1 and 1.2.6.2 of this FS. The Kalamazoo River has historically received substantial amounts of pollutants which has impacted current surface water and sediment concentrations.

Background air quality is not relevant to this proposed remedial action. No significant air quality impacts would be anticipated from the impacted media for the proposed remedial action at this site; groundwater, surface water and river sediments. Evaluations of the impact of the site to air quality were and are being addressed under Operable Unit I for this site; see Sections 6.4.4 and 6.9.4 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and Section 2.4 of the 1991 Operable Unit I Remedial Design/Remedial Action Workplan by Eder Associates Consulting Engineers.

(e) Current and reasonable foreseeable natural resource use.

There are no current or reasonable foreseeable uses of the small area of impacted shallow groundwater at the site as discussed in Section 1.2.6.1 of this FS. The Kalamazoo River is currently used for warm water recreational purposes, although there is a ban on fishing along this portion of the river due to elevated levels of PCBs from several known sources. It is reasonable to assume that remediation of PCBs in the Kalamazoo River may occur in the future and that the fishing ban may be removed. However, this proposed 35 Section 1.2.6.2 of this FS.

(f) Potential pathways of hazardous substance migration.

The potential pathways of hazardous substance migration through and from groundwater are discussed in Sections 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and in Sections 1.2.5 and 1.2.6 of this FS. The impacted groundwater discharges directly into the adjacent river which precludes migration of hazardous substances to areas where groundwater could be used as a drinking water source.

(g) All of the following with respect to hazardous substances at the site:

(i) Amount

The areal extent of impacted groundwater from the Auto Ion site is believed to be limited primarily to the site property. However, the horizontal extent of impacted groundwater off-site has not been determined. It is possible that the impacted groundwater from the Auto Ion site could extend beyond the site boundaries to the northern, eastern and western directions due to documented variable groundwater flow directions in response to changing river elevations from storm events. The extent of impacted groundwater in these off-site directions is expected to be minor compared to the on-site extent because the groundwater discharges in a southern direction into the river most of the time. The extent of impacted groundwater is discussed in Sections 3.4 and 5.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and Sections 1.2.4 and 1.3 of this FS.

The horizontal extent of impacted groundwater under the site is estimated to cover the entire area of the site; approximately 250' by 250'. The vertical extent of the impacted groundwater is estimated to be less than 20' deep (e.g. 10' to 30'). This area (250' x 250' x 20') is estimated to be 1,250,000 ft3. The effective porosity of the impacted shallow aquifer, based on site geology, has been estimated at 0.20. The estimated area of the impacted groundwater (1,250,000 ft3) was multiplied by the estimated effective porosity

(0.20) to determine the estimated volume of impacted groundwater which theoretically could be removed from soils in the aquifer (250,000 ft3). To account for the extent of impacted groundwater which may have migrated off-site in a direction other than south to the river, this estimate has been increased by 25% (312,500 ft3 or 8,850,000 liters). The mean concentration of each groundwater constituent in the shallow on-site monitoring wells (see Tables 1-5 and 1-6 from Section 1.2.6 of this FS) was multiplied by the volume of impacted groundwater (8,850,000 liters) to determine the total mass of each constituent in the impacted groundwater. The results are presented in Table J-1. This estimate may be low, since any constituents which may be adsorbed to soil particles in the aquifer have not been included.

(ii) Concentration

The concentrations of groundwater constituents are presented and discussed in Section 3.4 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Section 1.2.4 of this FS. In general, concentrations are low.

(iii) Form

The inorganic analytes and organic compounds are dissolved in the groundwater matrix. There are probably various inorganic salts and some organic compounds adsorbed to solid materials in the shallow aquifer. These constituents are expected to desorb into the groundwater over time as the concentrations of constituents in the aquifer decrease and cause changes in the chemical partitioning equilibriums. The form of constituents present in the impacted groundwater is discussed in Sections 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and in Section 1.2.5 of this FS.

AUTO ION SITE
KALAMAZOO, MICHIGAN

TABLE J-1

ESTIMATED TOTAL MASS OF ANALYTES/COMPOUNDS IN IMPACTED GROUNDWATER (1)

Inorganic Analyte	Mass (Kg)	Organic Compound	Mass (Kg)
Aluminum	150	Chloromethane	0.11
Antimony	-	Vinyl Chloride	0.13
Arsenic	0.19	Methylene Chloride	0.54
Barium	7.4	Trans-1,2-Dichloroethene	0.27
Beryllium	0.11	1,2-Dichloroethene(total)	0.17
Cadmium	0.11	1,2-Dichloroethane	0.071
Calcium	3,000	Chloroform	0.12
Total Chromium	3.9	Trichloroethene	0.57
Hexavalent Chromium	0.29	1,2-Dichlorobenzene	0.12
Cobalt	0.65	2,4-Dimethylphenol	-
Copper	2.1	2,4,6-Trichlorophenol	0.1
Cyanide	1.9	Diethylphthalate	-
Iron	500	Di-n-butylphthalate	(b)
Lead	9.7	Bis(2-ethylhexyl)phthalate	(b)
Magnesium	810		
Manganese	40		
Mercury	0.0071		
Nickel	27		
Potassium	320		
Selenium	-		
Silver	-		
Sodium	1,500		
Thallium	-		
Vanadium	0.57		
Zinc	7.7		

(1): Estimated from mean concentrations of on-site shallow monitoring wells. (See Tables 1-5 and 1-6) Non-detectable concentrations were assumed to be present and equal to the detection limit.

- : No significant detectable concentration (i.e., mean groundwater concentration equal to detection limit).

(b): Only present when in blank; sampling and/or laboratory contaminant.

g:\694031\tblmass

(iv) Mobility

The mobility of constituents in the impacted groundwater is discussed in Sections 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Remedial Investigation Report by Fred C. Hart and in Sections 1.2.5, 1.2.6.2 and Appendix F of this FS. In general, the organics readily move with the groundwater and the inorganics are much less mobile and tend to sorb onto soil particles.

(v) Bioaccumulative properties

The bioaccumulative properties of constituents in the impacted groundwater is discussed in Section 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart. In general, the constituents of concern are not bioaccumulative.

(vi) other characteristics of the hazardous substances which have a bearing on the appropriateness of the proposed plan.

The organic compounds of concern in the groundwater are biodegradable and volatile (J. Dragun, The Soil Chemistry of Hazardous Materials, 1988). As described in Section 1.2.4.2 of this FS, it appears that some organic compounds are undergoing natural biodegradation in the groundwater. When discharged into surface water, natural biodegradation of organics would be expected to increase in rate due to an expected increase in the availability of oxygen, nutrients and decomposing micro organisms.

(h) The extent to which the hazardous substances have migrated or are expected to migrate from the area of release.

Impacted groundwater from the site discharges into the Kalamazoo River. The low concentration of constituents of concern migrate in surface water until they are deposited in sediments, volatilize into the atmosphere, and/or biodegrade. The future extent of migration from the site is not expected to increase beyond the previous extent of migration. In fact, the potential for off-site contamination is expected to decrease. The potential for off-site migration is expected to decrease in the future due to the elimination of the source of contamination by the remediation of site soils during Operable Unit I. The measured extent of previous migration and fate and transport of the groundwater constituents is discussed in Sections 6.2, 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and in Sections 1.2.4, 1.2.5 and 1.2.6 of this FS. In general, impacted groundwater extends across the entire 1.5 acre site and discharges into the adjacent river.

(i) The impact of future migration of the hazardous substances.

The Baseline Risk Assessment in Section 1.2.6 of this FS evaluated the potential impact of future migration of the constituents and determined that there would be no adverse impact to receptors at current concentrations. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

(j) Current or potential contribution of the hazardous substances to food chain contamination.

When present in the groundwater, the constituents are not available to the food chain. Section 1.2.6.2 of this FS determined that the realistic worst case potential increase to concentrations of constituents in the river, from groundwater discharge, would be at least two or more orders of magnitude below surface water quality standard guidelines under Michigan Rule 57(2). These guidelines are designed to protect surface water use from wastewater discharges into surface waters. Since these water quality standards take the potential for food chain contribution into account, these levels are protective and below a level of concern for food chain contribution to contamination.

Operable Unit I will also eliminate the only remaining source of groundwater contamination from the site. Therefore, the discharge of constituents from the site are expected to decrease with time.

(k) Climate

The Auto Ion site is located in an area classified as a Humid Continental Cool Summer Climate, characterized by extended periods of elevated humidity and relatively cool, short summers and cold winters, with the frost season averaging less than 150 days.

Annual precipitation averages 32.51 inches in this region with the majority falling during June through September. Average temperatures range from 24.1°F in January to 73.9°F in July with an average annual temperature of 49.1°F.

The climatic conditions at this site do not have any adverse effects on this alternative remedial action.

(l) The technical feasibility and cost-effectiveness of remedial action alternatives, including alternatives which comply with Type B criteria.

The technical feasibility and cost effectiveness of this remedial action alternative are discussed in detail in Sections 7 and 8 of this FS. Operable Unit I will resolve the only remaining source of groundwater contamination from the Auto Ion site. Natural attenuation will substantially improve the groundwater quality with time. Since the source of the groundwater contamination will be removed, Type B cleanup criteria for the groundwater may eventually be achieved due to natural attenuation.

If other continuing off-site sources of groundwater contamination exist (see Section 1.3 of this FS) and are not remediated, a Type B level of cleanup for groundwater may not be achievable. It is also possible that the high retardation factors of some of the groundwater constituents (e.g. some metals) may result in an asymptotic endpoint at very low concentrations, which are still above Type B cleanup levels. This potential problem of not being able to achieve very low groundwater cleanup levels has become a widely recognized concern over the past few years as more experience in groundwater remediation is obtained. For these two reasons, it is unknown if a Type B cleanup can be attained for groundwater using a pump and treatment system or natural attenuation.

A Type B cleanup level for surface water would require that groundwater concentrations, before naturally discharging to surface water, be remediated to levels equivalent to or below surface water quality standards for a point source discharge pursuant to the requirements of Michigan Act 245, except no mixing zone would be allowed. Alternative 5 may be able to capture all impacted groundwater and Alternative 6 assures the capture of all impacted groundwater from the Auto Ion site and thus would prevent the exceedance of this Type B cleanup requirement. However, for the same reasons described in the previous paragraph and described in Section 7.3 of the FS, it may not even be technically feasible for Alternative 6 to achieve Type B cleanup levels. Alternative 6 is described in detail and compared to this proposed Type C alternative (No Further Action) in Sections 7 and 8 of this FS, respectively.

The proposed alternative (No Further Action) would not cost anything, while Alternative 6 is estimated to cost approximately $7,070,000. Since the CERCLA Baseline Risk Assessment did not identify any adverse impacts to human or natural resource receptors for the groundwater at current concentrations for both alternatives, Alternative 6 is not cost effective. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. The proposed Type C alternative (No Further Action) is cost effective.

(m) The evaluation of remedial action alternatives required by the provisions of R 299.5603.

(1) In assessing remedial action alternatives, the department shall consider all of the following:

(a) The effectiveness of alternatives in protecting the public health, safety, and welfare and the environment and natural resources.

The protection of public health, safety, and welfare and the environment and natural resources of this alternative have been evaluated in Sections 7 and 8 of this FS. This alternative is protective as determined in the CERCLA Baseline Risk Assessment. A Type B alternative would not be significantly more protective than this alternative and would require the expenditure of substantial energy and natural resources contributing to global environmental concerns. A pump and treatment alternative which may be capable of achieving a Type B cleanup alternative would also generate waste residue of concentrated hazardous substances that would probably need to be disposed at a hazardous waste landfill.

(b) The long-term uncertainties associated with the proposed remedial action.

The only long term uncertainties associated with this remedial action alternative concern the level of groundwater remediation natural attenuation would attain. If other continuing off-site sources of groundwater contamination exist (see Section 1.3 of this FS) and are not remediated, complete cleanup of the groundwater may not be achievable. It is also possible that the high retardation factors of some of the groundwater constituents (e.g. some metals) may result in an asymptotic endpoint at very low concentrations, which are still above cleanup goals. This potential problem of not being able to achieve very low groundwater cleanup levels has become a widely recognized concern over the past few years as more experience in groundwater remediation is obtained. These same uncertainties would apply to a Type B alternative.

<u>(c) The goals, objectives, and requirements of Act No. 641 of the Public Acts of 1978, as amended, being §299.401 et seq. of Michigan Compiled Laws, and known as the solid waste management act, and Act No. 64 of the Public Acts of 1979, as amended, being §299.501 et seq. of the Michigan Compiled Laws, and known as the hazardous waste management act.</u>

Some requirements of Michigan Act 64 would not be met until natural attenuation decreases the groundwater constituent concentrations by this alternative as described in the Compliance with ARARs subsection of Section 7.2.1.2 and Section 2.5.3 of this FS. These relate to monitoring and paperwork requirements for RCRA ACLs.

This alternative would not generate any solid or hazardous waste. The Type B alternative and Alternative 5 would generate concentrated waste material such as sludge and spent carbon.

<u>(d) The persistence, toxicity, mobility, and propensity to bioaccumulate of the hazardous substances.</u>

This information is contained in Section 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates. Upon discharging to the river the hazardous substances will be substantially reduced in concentrations well below toxic levels. Non-detectable concentrations would be present in the river. In general, these substances do not significantly bioaccumulate.

<u>(e) The short and long-term potential for adverse health effects from human exposure.</u>

This alternative is protective of human health given that no receptors are currently being adversely impacted by groundwater at the site. Specifically, the CERCLA Baseline Risk Assessment did not identify any impact from the groundwater concentrations currently discharging to the river. The only possibility of adversely impacting a receptor in the future would be if impacted groundwater were used as a drinking water source. It was determined that site-specific conditions made this potential extremely unlikely (see Baseline Risk Assessment). Existing institutional controls would restrict the use of the groundwater as a drinking water source for the foreseeable future during which time natural attenuation is expected to substantially improve groundwater quality.

(f) Costs of remedial action, including long-term maintenance costs, except that costs shall only be considered as specified in R 299.5601(3).

There are no costs for this alternative. Costs associated with other alternatives are presented in Sections 7 and 8 of this FS. The Type B alternative is estimated to cost $7,070,000.

(g) Reliability of the alternatives.

The proposed Type C cleanup would be completely reliable since there is no risk to public health or the environment as documented in this proposal. Active pump and treatment alternatives would be more subject to failure.

(h) The potential for future remedial action costs if an alternative fails.

The impact of failure would be insignificant since the source of groundwater contamination from the Auto Ion site will be removed by Operable Unit I and there are no receptors to be adversely impacted under any realistic future scenario as discussed in Section 1.2.6. of this FS. If in the future, another alternative was implemented, the costs would not be higher than implementing it now in lieu of this alternative.

(i) The potential threat to human health, safety and welfare and the environment and natural resources associated with excavation, transportation, and redisposal or containment.

These activities are not contemplated for this alternative.

(j) The ability to monitor remedial performance.

Due to the complex nature of variable groundwater flow direction at the site (see Section 1.2.5.2 of this FS) and the possible existence of other continuing off-site sources (see Section 1.3 of this FS), the ability to accurately monitor the groundwater quality is questionable. However, since there are no adversely impacted receptors (see Section 1.2.6 of this FS), this would not increase the potential for any adverse risk.

Groundwater quality below the Auto Ion site may be affected by upgradient sources, or by potential impact from groundwater flow direction reversals. To accurately monitor groundwater quality, seasonal variations and impact from off-site sources should be recorded.

(k) The public's perspective about the extent to which the proposed plan effectively addresses criteria specified in these rules.

Undetermined.

(2) Remedial actions that permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances are to be preferred.

The reduction of volume, toxicity and mobility of the impacted groundwater constituents for this alternative is discussed in Sections 7 and 8 of this FS. The source of contamination will be removed in Operable Unit I and groundwater constituent volume, toxicity and mobility are expected to decrease due to natural attenuation.

<u>(3) The off-site transport and disposal of hazardous substances or contaminated materials without treatment shall be the least favored remedial action alternative where practicable treatment technologies are available.</u>

The off-site transport and disposal of hazardous substances without treatment is not contemplated for this alternative.

<u>(n) The Uncertainties of the Risk Assessment</u>

The uncertainties of the risk assessment are contained in Section 7.1 of the 1989 Endangerment Assessment prepared by Fred C. Hart Associates. The risk assessment uses numerous safety factors and considers realistic worst case scenarios to be overly conservative to account for uncertainties.

<u>(o) The ability to monitor remedial performance, including the limitations of analytical methods.</u>

Due to the complex nature of variable groundwater flow direction at the site (see Section 1.2.5.2 of this FS) and the possible existence of other continuing off-site sources (see Section 1.3 of this FS), the ability to accurately monitor the groundwater quality is questionable. However, since there are no adversely impacted receptors (see Section 1.2.6 of this FS), this would not increase the potential for any adverse risk.

Groundwater quality below the Auto Ion site may be affected by upgradient sources, or by potential impact from groundwater flow direction reversals. To accurately monitor groundwater quality, seasonal variations and impact from off-site sources should be recorded.

The MDNR analytical detection limits of some parameters may not be achievable due to required USEPA CLP methodologies and/or matrix interferences.

(p) For remedial action plans which may impact the Great Lakes, consistency with the Great Lakes water quality agreement of 1978, as amended by protocol signed November 18, 1987, and the Great Lakes toxic substances control agreement of 1986.

No measurable concentrations of groundwater constituents will be present in the Kalamazoo River as determined in Section 1.2.6.2 of this FS. Therefore, this alternative would not impact the Great Lakes.

APPENDIX K

TYPE C CLEANUP JUSTIFICATION FOR ALTERNATIVE 2

PROPOSAL FOR TYPE C CLEANUP FOR ALTERNATIVE 2 (NATURAL ATTENUATION/INSTITUTIONAL CONTROLS)

In order to obtain approval for Michigan Act 307, Type C cleanup criteria, a proposal must be submitted to the MDNR which addresses all of the factors to be considered under Rule 5717. The proposed Type C criteria must be based on a site specific risk assessment which takes site conditions into account.

This proposal documents the site specific conditions at the Auto Ion site which meet the Michigan Act 307 Type C cleanup criteria for the Natural Attenuation/Institutional Controls Alternative for groundwater.

This remedial action alternative is limited to groundwater at the site. The unsaturated soil (source control) remedial action has already been addressed by Operable Unit I. Operable Unit I involves the excavation and off-site disposal of several thousand yards of contaminated soils at the site. Operable Unit I will eliminate the only remaining source of groundwater contamination from the Auto Ion site.

R 299.5717.2 Type C criteria shall be developed on the basis of a site-specific risk assessment, taking into account the following factors:

(a) The party who proposes the Type C remedial action shall demonstrate that the proposed criteria are appropriate for the site being considered.

A site specific risk assessment was completed for this site as part of the Remedial Investigation (RI) and is contained in 1989 Endangerment Assessment Report prepared by Fred C. Hart Associates. This risk assessment has been supplemented by the Baseline Risk Assessment for groundwater contained in Section 1.2.6 and groundwater Appendices F and I of this Feasibility Study (FS) report. The conceptual description of the proposed remedial action plan for this alternative is described in Section 7.2.2 of this FS. All Type C criteria are met for this alternative as specified in this document.

<u>(b) Type C criteria shall take into account reasonably foreseeable uses of the site and natural resources in question.</u>

As discussed in Section 1.2.6.1 of this FS, drinking water is not a reasonably foreseeable use for groundwater at this site. The impacted groundwater discharges into the Kalamazoo River. However, as discussed in Section 1.2.6.2 groundwater concentrations which discharge into the Kalamazoo River are too low to have any measurable impact on the river. The surface water concentration increase from these constituents is two or more orders of magnitude below surface water quality standard guidelines under Michigan Rule 57(2). These guidelines are designed to protect surface water use from wastewater discharges into surface waters. The CERCLA Baseline Risk Assessment did not identify any significant adverse impacts from the current groundwater concentrations discharging to the river. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. Therefore, this alternative would not restrict any reasonable foreseeable use of the site and natural resources.

<u>(c) Type C remedial actions shall take into account cost effectiveness.</u>

The cost effectiveness of this alternative have been evaluated in Sections 7 and 8 of this FS. This alternative is estimated to cost $565,000 whereas the Type B alternative is estimated to cost $7,070,000. Both alternatives are protective of human health and the environment in as much as no receptor is being adversely impacted by groundwater at the site. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. Therefore, this alternative is more cost effective than the Type B alternative.

R 299.5717.3 The party who proposes a Type C remedial action shall provide information about, and the department shall consider, all of the following factors as appropriate to the site in question:

(a) Potential exposure of human and natural resource targets.

The Baseline Risk Assessment in Section 1.2.6 of this FS evaluates potential exposure of human and natural resource targets. The Baseline Risk Assessment did not identify any adversely impacted receptor targets. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. The future use of impacted groundwater as a water source was determined to be extremely unlikely and restricted by institutional controls. The impacted groundwater concentrations which discharge to the Kalamazoo River were determined to have no significant impact in the Baseline Risk Assessment. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. Due to the extremely limited flow of the groundwater into the river, compared to the large river flow, it appears that any mixing zone, where biota may be potentially impacted, would be extremely small (see Section 1.2.6.2.6 of FS).

(b) Environmental media affected by contamination.

Three types of environmental media have been identified as being affected by the groundwater; groundwater, surface water and river sediments. The Baseline Risk Assessment in Section 1.2.6 of this FS determined that no adverse impact would occur to the river by groundwater at the concentrations evaluated. As concluded in the March 1993

Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. The sediments appear to have been impacted from previous conditions and/or upstream sources, rather than current site conditions.

(c) All of the following with respect to the physical setting of the site.

(i) Geology

The site geology is described in detail in Section 4.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site geological information is contained in Section 1.2.5 of this FS. The impacted groundwater is located in a sand gravel unit which is very permeable. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. This geology should allow the groundwater constituents to be readily flushed out over time under natural conditions.

(ii) Hydrology

The site hydrology is described in detail in Section 4.3 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site hydrological information is contained in Sections 1.2.5 and 1.2.6 of this FS. The Kalamazoo River maintains a large volume of flow at this locations which provides an ample dilution factor for the impacted groundwater discharging to it, even under low flow conditions (see Baseline Risk Assessment). As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

(iii) Soils

Soils at this site are being remediated under Operable Unit I as previously described. Detailed information concerning site soils is contained in the 1988 Remedial Investigation Report by Fred C. Hart Associates, the 1988 Operable Unit I Feasibility Study Report by Fred C. Hart Associates and the 1991 Operable Unit I Remedial Design/Remedial Action Work Plan by Eder Associates Consulting Engineers. The implementation of the Operable Unit I Remedial Action will eliminate the only remaining source of groundwater contamination from previous operations at the Auto Ion site.

(iv) Hydrogeology

The site hydrogeology is described in detail in Section 4.4 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site hydrogeological information is contained in Sections 1.2.5, 1.2.6, Appendix F and Appendix I of this FS. Groundwater discharges from the site into the adjacent river. There are no downgradient groundwater receptors other than the river.

(v) Other aspects of the physical setting which have a bearing on the appropriateness of the proposed plan.

Information which discusses the industrial setting and surrounding property use at the site, which is relevant to the proposed remedial alternative, is contained in Section 1.2 of this FS. This is an industrial/urbanized area where water is supplied by a municipal system. Groundwater contamination has been identified on adjacent properties, the impact of these on the Auto Ion site are unknown.

(d) Background groundwater, surface water, and air quality at the site.

Background groundwater data is contained in Sections 3.4 and 5.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Sections 1.2.1 and 1.2.4 of this FS. The potential for off-site background groundwater contamination migrating onto the Auto Ion site could prevent the groundwater from ever achieving Type B cleanup criteria under any remedial alternative.

Background surface water data is contained in Sections 3.7.3.1 and 5.3 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Sections 1.2.1 and 1.2.6.2 of this FS. The Kalamazoo River has historically received substantial amounts of pollutants which has impacted current surface water and sediment concentrations.

Background air quality is not relevant to this proposed remedial action. No significant air quality impacts would be anticipated from the impacted media for the proposed remedial action at this site; groundwater, surface water and river sediments. Evaluations of the impact of the site to air quality were and are being addressed under Operable Unit I for this site; see Section 6.4.4 and 6.4.9 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and Section 2.4 of the 1991 Operable Unit I Remedial Design/Remedial Action Workplan by Eder Associates Consulting Engineers.

(e) Current and reasonable foreseeable natural resource use.

There are no current or reasonable foreseeable uses of the small area of impacted shallow groundwater at the site as discussed in Section 1.2.6.1 of this FS. The Kalamazoo River is currently used for warm water recreational purposes, although there is a ban on fishing along this portion of the river due to elevated levels of PCBs from several known sources. It is reasonable to assume that remediation of PCBs in the Kalamazoo River may occur in the future and that the fishing ban may be removed. However, this proposed remedial action alternative would not impact any future uses of the river as determined in Section 1.2.6.2 of this FS.

(f) Potential pathways of hazardous substance migration.

The potential pathways of hazardous substance migration through and from groundwater are discussed in Sections 6.3.6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and in Sections 1.2.5 and 1.2.6 of this FS. The impacted groundwater discharges directly into the adjacent river which precludes migration of hazardous substances to areas where groundwater could be used as a drinking water source.

(g) All of the following with respect to hazardous substances at the site:

(i) Amount

The areal extent of impacted groundwater from the Auto Ion site is believed to be limited primarily to the site property. However, the horizontal extent of impacted groundwater off-site has not been determined. It is possible that the impacted groundwater from the Auto Ion site could extend beyond the site boundaries to the northern, eastern and western directions due to documented variable groundwater flow directions in response to changing river elevations from storm events. The extent of impacted groundwater in these off-site directions is expected to be minor compared to the on-site extent because the groundwater discharges in a southern direction into the river most of the time. The extent of impacted groundwater is discussed in Sections 3.4 and 5.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and Sections 1.2.4 and 1.3 of this FS.

The horizontal extent of impacted groundwater under the site is estimated to cover the entire area of the site; approximately 250' by 250'. The vertical extent of the impacted groundwater is estimated to be less than 20' deep (e.g. 10' to 30'). This area (250' x 250' x 20') is estimated to be 1,250,000 ft3. The effective porosity of the impacted shallow aquifer, based on site geology, has been estimated at 0.20. The estimated area of the impacted groundwater (1,250,000 ft3) was multiplied by the estimated effective porosity (0.20) to determine the estimated volume of impacted groundwater which theoretically could be removed from soils in the aquifer (250,000 ft3). To account for the extent of impacted groundwater which may have migrated off-site in a direction other than south to the river, this estimate has been increased by 25% (312,500 ft3 or 8,850,000 liters). The mean concentration of each groundwater constituent in the shallow on-site monitoring wells (see Tables 1-5 and 1-6 from Section 1.2.6 of this FS) was multiplied by the volume of impacted groundwater (8,850,000 liters) to determine the total mass of each constituent in the impacted groundwater. The results are presented in Table K-1. This estimate may be low, since any constituents which may be adsorbed to soil particles in the aquifer have not been included.

(ii) Concentration

The concentrations of groundwater constituents are presented and discussed in Section 3.4 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Section 1.2.4 of this FS.

(iii) Form

The inorganic analytes and organic compounds are dissolved in the groundwater matrix. There are probably various inorganic salts and some organic compounds adsorbed to solid materials in the shallow aquifer. These constituents are expected to desorb into the groundwater over time as the concentrations of constituents in the aquifer decrease and cause changes in the chemical partitioning equilibriums. The form of constituents present in the impacted groundwater is discussed in Sections 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and in Section 1.2.5 of this FS.

AUTO ION SITE
KALAMAZOO, MICHIGAN

TABLE K-1

ESTIMATED TOTAL MASS OF ANALYTES/COMPOUNDS IN IMPACTED GROUNDWATER (1)

Inorganic Analyte	Mass (Kg)	Organic Compound	Mass (Kg)
Aluminum	150	Chloromethane	0.11
Antimony	-	Vinyl Chloride	0.13
Arsenic	0.19	Methylene Chloride	0.54
Barium	7.4	Trans-1,2-Dichloroethene	0.27
Beryllium	0.11	1,2-Dichloroethene(total)	0.17
Cadmium	0.11	1,2-Dichloroethane	0.071
Calcium	3,000	Chloroform	0.12
Total Chromium	3.9	Trichloroethene	0.57
Hexavalent Chromium	0.29	1,2-Dichlorobenzene	0.12
Cobalt	0.65	2,4-Dimethylphenol	-
Copper	2.1	2,4,6-Trichlorophenol	0.1
Cyanide	1.9	Diethylphthalate	-
Iron	500	Di-n-butylphthalate	(b)
Lead	9.7	Bis(2-ethylhexyl)phthalate	(b)
Magnesium	810		
Manganese	40		
Mercury	0.0071		
Nickel	27		
Potassium	320		
Selenium	-		
Silver	-		
Sodium	1,500		
Thallium	-		
Vanadium	0.57		
Zinc	7.7		

(1): Estimated from mean concentrations of on-site shallow monitoring wells. (See Tables 1-5 and 1-6)
Non-detectable concentrations were assumed to be present and equal to the detection limit.

- : No significant detectable concentration (i.e., mean groundwater concentration equal to detection limit).

(b): Only present when in blank; sampling and/or laboratory contaminant.

(iv) Mobility

The mobility of constituents in the impacted groundwater is discussed in Sections 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart and in Sections 1.2.5, 1.2.6.2, and Appendix F of this FS. In general, the organics readily move with the groundwater and the inorganics are much less mobile and tend to sorb onto soil particles.

(v) Bioaccumulative properties

The bioaccumulative properties of constituents in the impacted groundwater is discussed in Section 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart. In general, the constituents of concern are not bioaccumulative.

(vi) other characteristics of the hazardous substances which have a bearing on the appropriateness of the proposed plan.

The organic compounds of concern in the groundwater are biodegradable and volatile (J. Dragun, The Soil Chemistry of Hazardous Materials, 1988). As described in Section 1.2.4.2 of this FS, it appears that some organic compounds are undergoing natural biodegradation in the groundwater. When discharged into surface water, natural biodegradation of organics would be expected to increase in rate due to an expected increase in the availability of oxygen, nutrients and decomposing micro organisms.

(h) The extent to which the hazardous substances have migrated or are expected to migrate from the area of release.

Impacted groundwater from the site discharges into the Kalamazoo River. The low concentration of constituents of concern migrate in surface water until they are deposited in sediments, volatilize into the atmosphere, and/or biodegrade. The future extent of migration from the site is not expected to increase beyond the previous extent of migration.

Operable Unit I will also eliminate the only remaining source of groundwater contamination from the site. Therefore, the discharge of constituents from the site are expected to decrease with time.

(k) Climate

The Auto Ion site is located in an area classified as a Humid Continental Cool Summer Climate, characterized by extended periods of elevated humidity and relatively cool, short summers and cold winters, with the frost season averaging less than 150 days.

Annual precipitation averages 32.51 inches in this region with the majority falling during June through September. Average temperatures range from 24.1°F in January to 73.9°F in July with an average annual temperature of 49.1°F.

The climatic conditions at this site do not have any adverse effects on this remedial action alternative.

(l) The technical feasibility and cost-effectiveness of remedial action alternatives, including alternatives which comply with Type B criteria.

The technical feasibility and cost effectiveness of this remedial action alternative are discussed in detail in Sections 7 and 8 of this FS. Operable Unit I will resolve the only remaining source of groundwater contamination from the Auto Ion site. Natural attenuation will substantially improve groundwater quality with time. Since the source of the groundwater contamination will be removed, Type B cleanup criteria for the groundwater may eventually be achieved under this alternative due to natural attenuation.

If other continuing off-site sources of groundwater contamination exist (see Section 1.3 of this FS) and are not remediated, a Type B level of cleanup for groundwater may not be achievable. It is also possible that the high retardation factors of some of the groundwater constituents (e.g. some metals) may result in an asymptotic endpoint at very low concentrations, which are still above Type B cleanup levels. This potential problem of not being able to achieve very low groundwater cleanup levels has become a widely recognized concern over the past few years as more experience in groundwater remediation is obtained. For these two reasons, it is unknown if a Type B cleanup can be attained for groundwater using a pump and treatment system or natural attenuation.

A Type B cleanup level for surface water would require that groundwater concentrations, before naturally discharging to surface water, be remediated to levels equivalent to or below surface water quality standards for a point source discharge pursuant to the requirements of Michigan Act 245, except no mixing zone would be allowed. Alternative 5 may be able to capture all impacted groundwater and Alternative 6 assures the capture of all impacted groundwater from the Auto Ion site and thus would prevent the exceedance of this Type B cleanup requirement. However, for the same reasons described in the previous paragraph and described in Section 7.3 of the FS, it may not even be technically feasible for Alternative 6 to achieve Type B cleanup levels. Alternative 6 is described in detail and compared to this proposed Type C alternative (Natural Attenuation/Institutional Controls) in Sections 7 and 8 of this FS, respectively.

The proposed alternative (Natural Attenuation/Institutional Controls) would cost approximately $565,000, while Alternative 6 is estimated to cost approximately $7,060,000 or approximately 13 times more than the proposed alternative. Since there are no short or long term adverse impacts to human or natural resource receptors for both alternatives, Alternative 6 is not cost effective. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. The proposed Type C alternative (Natural Attenuation/Institutional Controls) is cost effective.

(m) The evaluation of remedial action alternatives required by the provisions of R 299.5603.

(1) In assessing remedial action alternatives, the department shall consider all of the following:

(a) The effectiveness of alternatives in protecting the public health, safety, and welfare and the environment and natural resources.

The protection of public health, safety, and welfare and the environment and natural resources of this alternative have been evaluated in Sections 7 and 8 of this FS. This alternative is protective as determined in the CERCLA Baseline Risk Assessment. A Type B alternative would not be significantly more protective than this alternative and would require the expenditure of substantial energy and natural resources contributing to global environmental concerns. A pump and treatment alternative which may be capable of achieving a Type B cleanup alternative would also generate waste residue of concentrated hazardous substances that would probably need to be disposed of at a hazardous waste landfill.

(b) The long-term uncertainties associated with the proposed remedial action.

The only long term uncertainties associated with this remedial action alternative concern the level of groundwater remediation natural attenuation would attain. If other continuing off-site sources of groundwater contamination exist (see Section 1.3 of this FS) and are not remediated, complete cleanup of the groundwater may not be achievable. It is also possible that the high retardation factors of some of the groundwater constituents (e.g. some metals) may result in an asymptotic endpoint at very low concentrations, which are still above cleanup goals. This potential problem of not being able to achieve very low groundwater cleanup levels has become a widely recognized concern over the past few years as more experience in groundwater remediation is obtained. These same uncertainties would apply to a Type B alternative.

<u>(c) The goals, objectives, and requirements of Act No. 641 of the Public Acts of 1978, as amended, being §299.401 et seq. of Michigan Compiled Laws, and known as the solid waste management act, and Act No. 64 of the Public Acts of 1979, as amended, being §299.501 et seq. of the Michigan Compiled Laws, and known as the hazardous waste management act.</u>

All requirements of Michigan Act 64 would be met by this alternative as described in the Compliance with ARARs subsection of Section 7.2.2.2 and Section 2.5.3 of this FS. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

<u>(d) The persistence, toxicity, mobility, and propensity to bioaccumulate of the hazardous substances.</u>

This information is contained in Section 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates. Upon discharging to the river, the hazardous substances will be substantially reduced in concentrations well below toxic levels. Non-detectable concentrations would be present in the river. In general, these substances do not significantly bioaccumulate.

<u>(e) The short and long-term potential for adverse health effects from human exposure.</u>

This alternative is protective of human health given that no receptors are currently being adversely impacted by groundwater at the site. Specifically, the CERCLA Baseline Risk Assessment did not identify any adversely impacted receptors from the current groundwater concentrations. The only possibility of adversely impacting a receptor in the future would be the highly unlikely situation where impacted groundwater were used as a drinking water source. The Baseline Risk Assessment determined that site specific conditions made this potential extremely unlikely. Existing institutional controls would restrict the use of the groundwater as a water source over which time natural attenuation is expected to substantially improve groundwater quality. Additional institutional controls, including deed restriction and monitoring, provide additional redundant backup controls to prevent the use of the impacted groundwater quality improvements from natural attenuation in five years pursuant to CERCLA Section 121(c).

(f) Costs of remedial action, including long-term maintenance costs, except that costs shall only be considered as specified in R 299.5601(3).

The estimated costs for this and the other alternatives are presented in Sections 7 and 8 of this FS. This alternative is cost effective. It is 9 to 11 times less expensive than the pump and treatment Alternatives 5 and 6.

(g) Reliability of the alternatives.

The proposed Type C cleanup would be completely reliable since there is no risk to public health or the environment as documented in this proposal. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

(h) The potential for future remedial action costs if an alternative fails.

The impact of failure would be insignificant since the source of groundwater contamination from the Auto Ion site will be removed by Operable Unit I and there are no receptors to be adversely impacted under any realistic future scenario as discussed in Section 1.2.6. of the FS. If in the future, another alternative was implemented, the costs would not be higher than implementing it now in lieu of this alternative.

(i) The potential threat to human health, safety and welfare and the environment and natural resources associated with excavation, transportation, and redisposal or containment.

These activities are not contemplated for this alternative.

(j) The ability to monitor remedial performance.

Due to the complex nature of variable groundwater flow direction at the site (see Section 1.2.5.2 of this FS) and the possible existence of other continuing off-site sources (see Section 1.3 of this FS), the ability to accurately monitor the groundwater quality is questionable. However, since there are no adversely impacted receptors (see Section 1.2.6 of this FS), this would not increase the potential for any adverse risk.

Groundwater quality below the Auto Ion site may be affected by upgradient sources, or by potential impact from groundwater flow direction reversals. To accurately monitor groundwater quality, seasonal variations and impact from off-site sources should be recorded.

(k) The public's perspective about the extent to which the proposed plan effectively addresses criteria specified in these rules.

Undetermined.

(2) Remedial actions that permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances are to be preferred.

The reduction of volume, toxicity and mobility of the impacted groundwater constituents for this alternative is discussed in Sections 7 and 8 of this FS. The source of contamination will be removed in Operable Unit I and groundwater constituent volume, toxicity and mobility are expected to decrease due to natural attenuation.

(3) The off-site transport and disposal of hazardous substances or contaminated materials without treatment shall be the least favored remedial action alternative where practicable treatment technologies are available.

The off-site transport and disposal of hazardous substances without treatment is not contemplated for this alternative.

(n) The uncertainties of the risk assessment

The uncertainties of the risk assessment are contained in Section 7.1 of the 1989 Endangerment Assessment prepared by Fred C. Hart Associates. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

(o) The ability to monitor remedial performance, including the limitations of analytical methods.

Due to the complex nature of variable groundwater flow direction at the site (see Section 1.2.5.2 of this FS) and the possible existence of other continuing off-site sources (see Section 1.3 of this FS), the ability to accurately monitor the groundwater quality is questionable. However, since there are no adversely impacted receptors (see Section 1.2.6 of this FS), this would not increase the potential for any adverse risk.

Groundwater quality below the Auto Ion site may be affected by upgradient sources, or by potential impact from groundwater flow direction reversals. To accurately monitor groundwater quality, seasonal variations and impact from off-site sources should be recorded.

The MDNR analytical detection limits of some parameters may not be achievable due to required USEPA CLP methodologies and/or matrix interferences.

(p) For remedial action plans which may impact the Great Lakes, consistency with the Great Lakes water quality agreement of 1978, as amended by protocol signed November 18, 1987, and the Great Lakes toxic substances control agreement of 1986.

No measurable concentrations of groundwater constituents will be present in the Kalamazoo River as determined in Section 1.2.6.2 of this FS. Therefore, this alternative would not impact the Great Lakes.

APPENDIX L

TYPE C CLEANUP JUSTIFICATION FOR ALTERNATIVE 5

TYPE C CLEANUP JUSTIFICATION FOR ALTERNATIVE 5 (GROUNDWATER CONTAINMENT VIA LOW FLOW EXTRACTION/METALS TREATMENT/ FILTRATION/DISCHARGE TO A POTW)

In order to obtain approval for Michigan Act 307, Type C cleanup criteria, a proposal must be submitted to the MDNR which addresses all of the factors to be considered under Rule 5717. The proposed Type C criteria must be based on a site specific risk assessment which takes site conditions into account.

This proposal documents the site specific conditions at the Auto Ion site which meet the Michigan Act 307 Type C cleanup criteria for the Groundwater Containment Via Low Flow Extraction/Metals Treatment/Filtration/Discharge to a POTW Alternative for groundwater.

This remedial action alternative is limited to groundwater at the site. The unsaturated soil (source control) remedial action has already been addressed by Operable Unit I. Operable Unit I involves the excavation and off-site disposal of several thousand yards of contaminated soils at the site. Operable Unit I will eliminate the only remaining source of groundwater contamination from the Auto Ion site.

R 299.5717.2 Type C criteria shall be developed on the basis of a site-specific risk assessment, taking into account the following factors:

(a) The party who proposes the Type C remedial action shall demonstrate that the proposed criteria are appropriate for the site being considered.

A site specific risk assessment was completed for this site as part of the Remedial Investigation (RI) and is contained in the 1989 Endangerment Assessment Report prepared by Fred C. Hart Associates. This risk assessment has been supplemented by the Baseline Risk Assessment for groundwater contained in Section 1.2.6 and groundwater Appendices

F and I of this Feasibility Study (FS) report. The conceptual description of the proposed remedial action plan for this alternative is described in Section 7.4.3 of this FS. All Type C criteria are met for this alternative as specified in this document.

<u>(b) Type C criteria shall take into account reasonably foreseeable uses of the site and natural resources in question.</u>

As discussed in Section 1.2.6.1 of this FS, drinking water is not a reasonably foreseeable use for groundwater at this site. The impacted groundwater discharges into the Kalamazoo River. However, as discussed in Section 1.2.6.2, groundwater concentrations which discharge into the Kalamazoo River are too low to have any measurable impact on the river. The surface water concentration increase from these constituents is two or more orders of magnitude below surface water quality standard guidelines under Michigan Rule 57(2). These guidelines are designed to protect surface water use from wastewater discharges into surface waters. Under this alternative substantially less impacted groundwater would be allowed to discharge to the river than assumed in the Baseline Risk Assessment. The CERCLA Baseline Risk Assessment did not identify any significant adverse impacts from the current groundwater concentrations discharging to the river. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. Therefore, this alternative would not restrict any reasonable foreseeable use of the site and natural resources.

<u>(c) Type C remedial actions shall take into account cost effectiveness.</u>

The cost effectiveness of this alternative have been evaluated in Sections 7 and 8 of this FS. This alternative is estimated to cost $5,650,000. Alternatives 1 and 2 are substantially less costly ($0.00 and $565,000), respectively, and provide an equivalent level of protection. Therefore, this alternative is not cost effective compared to these alternatives. This alternative is cost effective compared to alternative 6 ($7,070,000).

R 299.5717.3 The party who proposes a Type C remedial action shall provide information about, and the department shall consider, all of the following factors as appropriate to the site in question:

(a) Potential exposure of human and natural resource targets.

The Baseline Risk Assessment in Section 1.2.6 of this FS evaluates potential exposure of human and natural resource targets. The Baseline Risk Assessment did not identify any adversely impacted receptor targets. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. The future use of impacted groundwater as a water source was determined to be extremely unlikely and restricted by institutional controls. The impacted groundwater concentrations which discharge to the Kalamazoo River were determined to have no significant impact in the Baseline Risk Assessment. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. Due to the extremely limited flow of the groundwater into the river, compared to the large river flow, it appears that any mixing zone, where biota may be potentially impacted, would be extremely small (see Section 1.2.6.2.6 of FS).

(b) Environmental media affected by contamination.

Three types of environmental media have been identified as being affected by the groundwater; groundwater, surface water and river sediments. The Baseline Risk Assessment in Section 1.2.6 of this FS determined that no adverse impact would occur to the river by groundwater at the concentrations evaluated. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. The sediments appear to have been impacted from previous conditions and/or upstream sources, rather than current site conditions.

(c) All of the following with respect to the physical setting of the site.

(i) Geology

The site geology is described in detail in Section 4.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site geological information is contained in Section 1.2.5 of this FS. The impacted groundwater is located in a sand gravel unit which is very permeable. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River. This geology should allow the groundwater constituents to be readily flushed out over time under natural conditions.

(ii) Hydrology

The site hydrology is described in detail in Section 4.3 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site hydrological information is contained in Sections 1.2.5 and 1.2.6 of this FS. The Kalamazoo River maintains a large volume of flow at this location which provides an ample dilution factor for the impacted groundwater discharging to it, even under low flow conditions (see Baseline Risk Assessment). The quantity of impacted groundwater which may not be captured is expected to be minimal. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

(iii) Soils

Soils at this site are being remediated under Operable Unit I as previously described. Detailed information concerning site soils is contained in the 1988 Remedial Investigation Report by Fred C. Hart Associates, the 1988 Operable Unit I Feasibility Study Report by Fred C. Hart Associates and the 1991 Operable Unit I Remedial Design/Remedial Action Work Plan by Eder Associates Consulting Engineers. The implementation of the Operable Unit I Remedial Action will eliminate the only remaining source of groundwater contamination from previous operations at the Auto Ion site.

(iv) Hydrogeology

The site hydrogeology is described in detail in Section 4.4 of the 1988 Remedial Investigation Report by Fred C. Hart Associates. Supplemental site hydrogeological information is contained in Sections 1.2.5, 1.2.6, Appendix F and Appendix I of this FS. Groundwater discharges from the site into the adjacent river. There are no downgradient groundwater receptors other than the river.

(v) Other aspects of the physical setting which have a bearing on the appropriateness of the proposed plan.

Information which discusses the industrial setting and surrounding property use at the site, which is relevant to the proposed remedial alternative, is contained in Section 1.2 of this FS. This is an industrial/urbanized area where water is supplied by a municipal system. Groundwater contamination has been identified on adjacent properties, the impact of these on the Auto Ion site are unknown.

(d) Background groundwater, surface water, and air quality at the site.

Background groundwater data is contained in Sections 3.4 and 5.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Sections 1.2.1 and 1.2.4 of this FS. The potential for off-site background groundwater contamination migrating onto the Auto Ion site could prevent the groundwater from ever achieving Type B cleanup criteria under any remedial alternative.

Background surface water data is contained in Sections 3.7.3.1 and 5.3 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Sections 1.2.1 and 1.2.6.2 of this FS. The Kalamazoo River has historically received substantial amounts of pollutants which has impacted current surface water and sediment concentrations.

Background air quality is not relevant to this proposed remedial action. No significant air quality impacts would be anticipated from the extraction/treatment system or from the impacted media for the proposed remedial action at this site (groundwater, surface water and river sediments). Evaluations of the impact of the site to air quality were and are being addressed under Operable Unit I for this site; see Sections 6.4.4 and 6.9.4 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and Section 2.4 of the 1991 Operable Unit I Remedial Design/Remedial Action Work Plan by Eder Associates Consulting Engineers.

(e) Current and reasonable foreseeable natural resource use.

There are no current or reasonable foreseeable uses of the small area of impacted shallow groundwater at the site as discussed in Section 1.2.6.1 of this FS. The Kalamazoo River is currently used for warm water recreational purposes, although there is a ban on fishing along this portion of the river due to elevated levels of PCBs from several known sources. It is reasonable to assume that remediation of PCBs in the Kalamazoo River may occur in the future and that the fishing ban may be removed. However, this proposed remedial action alternative would not impact any future uses of the river as determined in Section 1.2.6.2 of this FS.

(f) Potential pathways of hazardous substance migration.

The potential pathways of hazardous substance migration through and from groundwater are discussed in Sections 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and in Sections 1.2.5 and 1.2.6 of this FS. The impacted groundwater discharges directly into the adjacent river which precludes migration of hazardous substances to areas where groundwater could be used as a drinking water source.

(g) All of the following with respect to hazardous substances at the site:

(i) Amount

The areal extent of impacted groundwater from the Auto Ion site is believed to be limited primarily to the site property. However, the horizontal extent of impacted groundwater off-site has not been determined. It is possible that the impacted groundwater from the Auto Ion site could extend beyond the site boundaries to the northern, eastern and western directions due to documented variable groundwater flow directions in response to changing river elevations from storm events. The extent of impacted groundwater in these off-site directions is expected to be minor compared to the on-site extent because the groundwater discharges in a southern direction into the river most of the time. The extent of impacted groundwater is discussed in Sections 3.4 and 5.2 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and Sections 1.2.4 and 1.3 of this FS.

The horizontal extent of impacted groundwater under the site is estimated to cover the entire area of the site; approximately 250' by 250'. The vertical extent of the impacted groundwater is estimated to be less than 20' deep (e.g. 10' to 30'). This area (250' x 250' x 20') is estimated to be 1,250,000 ft3. The effective porosity of the impacted shallow aquifer, based on site geology, has been estimated at 0.20. The estimated area of the impacted groundwater (1,250,000 ft3) was multiplied by the estimated effective porosity (0.20) to determine the estimated volume of impacted groundwater which theoretically could be removed from soils in the aquifer (250,000 ft3). To account for the extent of impacted groundwater which may have migrated off-site in a direction other than south to the river, this estimate has been increased by 25% (312,500 ft3 or 8,850,000 liters). The mean concentration of each groundwater constituent in the shallow on-site monitoring wells (see Tables 1-5 and 1-6 from Section 1.2.6 of this FS) was multiplied by the volume of impacted groundwater (8,850,000 liters) to determine the total mass of each constituent in the impacted groundwater. The results are presented in Table L-1. This estimate may be low, since any constituents which may be adsorbed to soil particles in the aquifer have not been included.

(ii) Concentration

The concentrations of groundwater constituents are presented and discussed in Section 3.4 of the 1988 Remedial Investigation Report by Fred C. Hart Associates and in Section 1.2.4 of this FS. In general, concentrations are low.

AUTO ION SITE
KALAMAZOO, MICHIGAN

TABLE L-1

ESTIMATED TOTAL MASS OF ANALYTES/COMPOUNDS IN IMPACTED GROUNDWATER (1)

Inorganic Analyte	Mass (Kg)	Organic Compound	Mass (Kg)
Aluminum	150	Chloromethane	0.11
Antimony	-	Vinyl Chloride	0.13
Arsenic	0.19	Methylene Chloride	0.54
Barium	7.4	Trans-1,2-Dichloroethene	0.27
Beryllium	0.11	1,2-Dichloroethene(total)	0.17
Cadmium	0.11	1,2-Dichloroethane	0.071
Calcium	3,000	Chloroform	0.12
Total Chromium	3.9	Trichloroethene	0.57
Hexavalent Chromium	0.29	1,2-Dichlorobenzene	0.12
Cobalt	0.65	2,4-Dimethylphenol	-
Copper	2.1	2,4,6-Trichlorophenol	0.1
Cyanide	1.9	Diethylphthalate	-
Iron	500	Di-n-butylphthalate	(b)
Lead	9.7	Bis(2-ethylhexyl)phthalate	(b)
Magnesium	810		
Manganese	40		
Mercury	0.0071		
Nickel	27		
Potassium	320		
Selenium	-		
Silver	-		
Sodium	1,500		
Thallium	-		
Vanadium	0.57		
Zinc	7.7		

(1): Estimated from mean concentrations of on-site shallow monitoring wells. (See Tables 1-5 and 1-6) Non-detectable concentrations were assumed to be present and equal to the detection limit.

- : No significant detectable concentration (i.e., mean groundwater concentration equal to detection limit).

(b): Only present when in blank; sampling and/or laboratory contaminant.

(iii) Form

The inorganic analytes and organic compounds are dissolved in the groundwater matrix. There are probably various inorganic salts and some organic compounds adsorbed to solid materials in the shallow aquifer. These constituents are expected to desorb into the groundwater over time as the concentrations of constituents in the aquifer decrease and cause changes in the chemical partitioning equilibriums. The form of constituents present in the impacted groundwater is discussed in Sections 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and in Section 1.2.5 of this FS.

(iv) Mobility

The mobility of constituents in the impacted groundwater is discussed in Sections 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart and in Sections 1.2.5, 1.2.6.2 and Appendix F of this FS. In general, the organics readily move with the groundwater and the inorganics are much less mobile and tend to sorb onto soil particles.

(v) Bioaccumulative properties

The bioaccumulative properties of constituents in the impacted groundwater is discussed in Section 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart. In general, the constituents of concern are not bioaccumulative.

(vi) other characteristics of the hazardous substances which have a bearing on the appropriateness of the proposed plan.

The organic compounds of concern in the groundwater are biodegradable and volatile (J. Dragun, The Soil Chemistry of Hazardous Materials, 1988). As described in Section 1.2.4.2 of this FS, it appears that some organic compounds are undergoing natural biodegradation in the groundwater. If groundwater naturally discharges into surface water, natural biodegradation of organics would be expected to increase in rate due to an expected increase in the availability of oxygen, nutrients and decomposing micro organisms.

(h) The extent to which the hazardous substances have migrated or are expected to migrate from the area of release.

Impacted groundwater from the site discharges into the Kalamazoo River. The low concentration of constituents of concern migrate in surface water until they are deposited in sediments, volatilize into the atmosphere, and/or biodegrade. The future extent of migration from the site is not expected to increase beyond the previous extent of migration. In fact, potential for off-site contamination is expected to decrease. The potential for off-site migration is expected to decrease in the future due to the elimination of the source of containment by the remediation of site soils during Operable Unit I. The containment of groundwater on-site would control the future migration of constituents. The measured extent of previous migration and fate and transport of the groundwater constituents is discussed in Sections 6.2, 6.3, 6.4 and 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates and in Sections 1.2.4, 1.2.5 and 1.2.6 of this FS.

(i) The impact of future migration of the hazardous substances.

The Baseline Risk Assessment in Section 1.2.6 of this FS evaluated the potential impact of future migration of the constituents and determined that there would be no adverse impact to receptors at current concentrations. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

(j) Current or potential contribution of the hazardous substances to food chain contamination.

When present in the groundwater, the constituents are not available to the food chain. Section 1.2.6.2 of this FS determined that the realistic worst case potential increase to concentrations of constituents in the river, from groundwater discharge, would be at least two or more orders of magnitude below surface water quality standard guidelines under Michigan Rule 57(2). These guidelines are designed to protect surface water use from wastewater discharges into surface waters. Since these water quality standards take the potential for food chain contribution into account, these levels are protective and below a level of concern for food chain contribution to contamination.

Operable Unit I will also eliminate the only remaining source of groundwater contamination from the site. Therefore, the discharge of constituents from the site are expected to decrease with time.

(k) Climate

The Auto Ion site is located in an area classified as a Humid Continental Cool Summer Climate, characterized by extended periods of elevated humidity and relatively cool, short summers and cold winters, with the frost season averaging less than 150 days.

Annual precipitation averages 32.51 inches in this region with the majority falling during June through September. Average temperatures range from 24.1°F in January to 73.9°F in July with an average annual temperature of 49.1°F.

The climatic conditions at this site do not have any adverse effects on this remedial action alternative.

(l) The technical feasibility and cost-effectiveness of remedial action alternatives, including alternatives which comply with Type B criteria.

The technical feasibility and cost effectiveness of this remedial action alternative are discussed in detail in Sections 7 and 8 of this FS. Active treatment and possibly natural attenuation is expected to substantially improve groundwater quality with time. Since the source of the groundwater contamination will be removed, Type B cleanup criteria for the groundwater may eventually be achieved due to active treatment.

If other continuing off-site sources of groundwater contamination exist (see Section 1.3 of this FS) and are not remediated, a Type B level of cleanup for groundwater may not be achievable. It is also possible that the high retardation factors of some of the groundwater constituents (e.g. some metals) may result in an asymptotic endpoint at very low concentrations, which are still above Type B cleanup levels. This potential problem of not being able to achieve very low groundwater cleanup levels has become a widely recognized concern over the past few years as more experience in groundwater remediation is obtained. For these two reasons, it is unknown if a Type B cleanup can be attained for groundwater using a pump and treatment system and/or natural attenuation.

A Type B cleanup level for surface water would require that groundwater concentrations, before naturally discharging to surface water, be remediated to levels equivalent to or below surface water quality standards for a point source discharge pursuant to the requirements of Michigan Act 245, except no mixing zone would be allowed. Although it may be possible for this alternative to recover all the impacted groundwater, only remedial action Alternative 6 assures the capture of all impacted groundwater from the Auto Ion site and would thus prevent the exceedance of this Type B cleanup requirement. However, for the same reasons described in the previous paragraph and described in Section 7.3 of the FS, it may not even be technically feasible for Alternative 6 to achieve Type B cleanup levels. Alternative 6 is described in detail and compared to this proposed alternative (Groundwater Containment Via Low Flow Extraction/Metals Treatment/ Filtration/Discharge to a POTW) in Sections 7 and 8 of this FS, respectively.

The proposed alternative (Groundwater Containment Via Low Flow Extraction/ Metals Treatment/Filtration/Discharge to a POTW) would cost approximately $5,650,000, while Alternative 6 is estimated to cost approximately $7,070,000. Since the CERCLA Baseline Risk Assessment did not identify any adverse impacts to human or natural resource receptors for the groundwater at current concentrations for any of the groundwater remedial action alternatives, Alternative 5 is more cost effective than Alternative 6. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

(m) The evaluation of remedial action alternatives required by the provisions of R 299.5603.

(1) In assessing remedial action alternatives, the department shall consider all of the following:

(a) The effectiveness of alternatives in protecting the public health, safety, and welfare and the environment and natural resources.

The protection of public health, safety, and welfare and the environment and natural resources of this alternative have been evaluated in Sections 7 and 8 of this FS. This alternative is protective as determined in the CERCLA Baseline Risk Assessment. A Type B Alternative would not be significantly more protective than this alternative and would require the expenditure of additional energy and natural resources, contributing to global environmental concerns.

(b) The long-term uncertainties associated with the proposed remedial action.

The only long-term uncertainties associated with this remedial action alternative concern the level of groundwater remediation active extraction/treatment would attain. If other continuing off-site sources of groundwater contamination exist (see Section 1.3 of this FS) and are not remediated, complete cleanup of the groundwater may not be achievable. It is also possible that the high retardation factors of some of the groundwater constituents (e.g. some metals) may result in an asymptotic endpoint at very low concentrations, which are still above cleanup goals. This potential problem of not being able to achieve very low groundwater cleanup levels has become a widely recognized concern over the past few years as more experience in groundwater remediation is obtained. These same uncertainties would apply to a Type B alternative.

(c) The goals, objectives, and requirements of Act No. 641 of the Public Acts of 1978, as amended, being §299.401 et seq. of Michigan Compiled Laws, and known as the solid waste management act, and Act No. 64 of the Public Acts of 1979, as amended, being §299.501 et seq. of the Michigan Compiled Laws, and known as the hazardous waste management act.

All requirements of Michigan Act 64 would be met by this alternative as described in the Compliance with ARARs subsection of Section 7.2.3.2 and Section 2.5.3 of this FS. This alternative would generate solid and/or hazardous waste such as sludge and spent carbon.

(d) The persistence, toxicity, mobility, and propensity to bioaccumulate of the hazardous substances.

This information is contained in Section 6.5 of the 1989 Endangerment Assessment Report by Fred C. Hart Associates. Upon discharging to the river, the hazardous substances will be substantially reduced in concentrations well below toxic levels. Non-detectable concentrations would be present in the river. In general, these substances do not significantly bioaccumulate.

(e) The short and long-term potential for adverse health effects from human exposure.

The short and long term potential for adverse health effects from human exposure for this alternative are discussed in Sections 7 and 8 of this FS. The CERCLA Baseline Risk Assessment did not identify any short or long-term adverse health effects from human exposure under this alternative.

(f) Costs of remedial action, including long-term maintenance costs, except that costs shall only be considered as specified in R 299.5601(3).

The estimated costs for this and the other alternatives are presented in Sections 7 and 8 of this FS. This alternative is more cost effective than the Type B alternative and provides the same level of protection.

(g) Reliability of the alternatives.

The proposed Type C cleanup would be less reliable than Alternatives 1 and 2. However, there is no risk to public health or the environment if it fails as documented in this FS.

(h) The potential for future remedial action costs if an alternative fails.

The impact of failure would be insignificant since the source of groundwater contamination from the Auto Ion site will be removed by Operable Unit I and there are no receptors to be adversely impacted under any realistic future scenario as discussed in Section 1.2.6. of the FS. If in the future, another alternative was implemented, the costs would not be higher than implementing it now in lieu of this alternative.

(i) The potential threat to human health, safety and welfare and the environment and natural resources associated with excavation, transportation, and redisposal or containment.

Sludges and possibly spent carbon would be generated as part of this alternative. The volume would be expected to be low and the off-site transportation and disposal would result in a minor threat to human health and the environment.

(j) The ability to monitor remedial performance.

Due to the complex nature of variable groundwater flow direction at the site (see Section 1.2.5.2 of this FS) and the possible existence of other continuing off-site sources (see Section 1.3 of this FS), the ability to accurately monitor the groundwater quality is questionable. However, since there are no adversely impacted receptors (see Section 1.2.6 of this FS), this would not increase the potential for any adverse risk.

Groundwater quality below the Auto Ion site may be affected by upgradient sources, or by potential impact from groundwater flow direction reversals. To accurately monitor groundwater quality, seasonal variations and impact from off-site sources should be recorded.

(k) The public's perspective about the extent to which the proposed plan effectively addresses criteria specified in these rules.

Undetermined.

(2) Remedial actions that permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances are to be preferred.

The reduction of volume, toxicity and mobility of the impacted groundwater constituents for this alternative is discussed in Sections 7 and 8 of this FS. Volume, toxicity and mobility are reduced through treatment of the impacted groundwater.

<u>(3) The off-site transport and disposal of hazardous substances or contaminated materials without treatment shall be the least favored remedial action alternative where practicable treatment technologies are available.</u>

The off-site transport and disposal of hazardous substances without treatment is not contemplated for any of the groundwater alternatives at this site.

<u>(n) The uncertainties of the Risk Assessment</u>

The uncertainties of the risk assessment are contained in Section 7.1 of the 1989 Endangerment Assessment prepared by Fred C. Hart Associates. As concluded in the March 1993 Sediment Toxicity Evaluation Report, there would not be a measurable effect on water quality due to the large flow in the river as compared to the groundwater flux to the river. The results of the evaluation also supports a similar conclusion that there is no discernible impact on the aquatic macroinvertebrate community of the Kalamazoo River.

<u>(o) The ability to monitor remedial performance, including the limitations of analytical methods.</u>

Due to the complex nature of variable groundwater flow direction at the site (see Section 1.2.5.2 of this FS) and the possible existence of other continuing off-site sources (see Section 1.3 of this FS), the ability to accurately monitor the groundwater quality is questionable. However, since there are no adversely impacted receptors (see Section 1.2.6 of this FS), this would not increase the potential for any adverse risk.

Groundwater quality below the Auto Ion site may be affected by upgradient sources, or by potential impact from groundwater flow direction reversals. To accurately monitor groundwater quality, seasonal variations and impact from off-site sources should be recorded.

The MDNR analytical detection limits of some parameters may not be achievable due to required USEPA CLP methodologies and/or matrix interferences.

(p) For remedial action plans which may impact the Great Lakes, consistency with the Great Lakes water quality agreement of 1978, as amended by protocol signed November 18, 1987, and the Great Lakes toxic substances control agreement of 1986.

No measurable concentrations of groundwater constituents will be present in the Kalamazoo River as determined in Section 1.2.6.2 of this FS. If any impacted groundwater is discharged directly to surface water it would contain substantially less constituents than were evaluated in the Baseline Risk Assessment. Therefore, this alternative would not impact the Great Lakes.

APPENDIX M

GROUNDWATER ADMINISTRATIVE CONTROLS

APPLICATION AND PERMIT TO INSTALL WATER SUPPLY FACILITIES

For Health Department Use
Well Permit Number
Corresponding Sewage Permit No.
WSSN

Permit To:

_____ Construct a Public Well Under Act 399, P.A. 1976 or Sanitary Code

_____ Alter a Public Water Supply Under Act 399, P.A. 1976 or Sanitary Code

ESTABLISHMENT NAME _____ ADDRESS _____ CITY _____ ZIP _____

COUNTY _____ TOWNSHIP _____ TOWN _____ N/S RANGE _____ E/W SECTION _____ FRACTION _____ ¼ _____ ¼

OWNER/MANAGER _____ ADDRESS _____ CITY _____ ZIP _____

BUSINESS TELEPHONE _____ / _____ OWNERSHIP GOVERNMENT ☐ PRIVATE ☐ AVERAGE NO. OF PERSONS SERVED PER DAY _____

NO. OF SERVICE CONNECTIONS _____ PREMISE TYPE _____ (Campground, School, Airport, etc.) LICENSE TYPE _____ (Campground, Food, DSS, Migrant Labor, etc.)

IF SEASONAL: FROM _____ TO _____ WELL CONTRACTOR _____ TELEPHONE _____ / _____ PUMP INSTALLER _____

APPLICANT'S NAME _____ ADDRESS _____ CITY _____ ZIP _____

I hereby apply for this permit and have authorization to do so. I understand this is a construction permit only, and that the well is not to be put into service until final approval has been granted. I further state the information given is accurate and complete.

Applicant's Signature: _____ Date _____ Phone _____

(FOR HEALTH DEPARTMENT USE ONLY — DO NOT WRITE IN SHADED AREA)

WELL SITE EVALUATION INFORMATION
DATE OF EVALUATION _____ By _____
CLASSIFICATION: TYPE IIA TYPE IIB
(IF ISOLATION DISTANCES ARE LESS THAN ESTABLISHED MINIMUM STANDARDS, COMPLETE DEVIATIONS SECTION)
STANDARD ISOLATION AREA _____ FT.
MAJOR ISOLATION AREA _____ FT.
PERMIT CONDITIONS/DEVIATIONS: _____

WELL CONSTRUCTION PERMIT: APPROVAL / DENIAL
DO NOT PROCEED WITH CONSTRUCTION WITHOUT SIGNATURE FROM HEALTH DEPARTMENT REPRESENTATIVE.
By _____ Date _____
(Not valid unless signed by the Health Department)
REQUIRED MINIMUM CAPACITY _____

FINAL INSPECTION DATE _____ BY _____

WELL: CASING TERMINATION APPROVED: YES ☐ NO ☐
WELL LOCATION APPROVED: YES ☐ NO ☐
WELL CONSTRUCTION SATISFACTORY: YES ☐ NO ☐
VENTED: YES ☐ NO ☐
BURIED SUCTION LINE PROTECTED: YES ☐ NO ☐ N.A. ☐

PUMP: SHALLOW WELL JET ☐ DEEP WELL JET ☐
SUBMERSIBLE ☐ HAND PUMP ☐ TURBINE ☐
OTHER _____ ☐

PIPING: MATERIALS: MATERIAL _____
PRESSURE RATING _____ PSI ASTM # _____

STORAGE: TYPE _____
LOCATION _____
CAPACITY _____ GALLONS OPERATING RANGE _____ - _____

TREATMENT: TYPE (IF ANY) _____
LOCATION _____

TEST RESULTS: BACTERIOLOGIC (1ST.) _____
DATE COLLECTED _____
BACTERIOLOGIC (2ND) _____
DATE COLLECTED _____
NITRATE _____ MG/L
DATE COLLECTED _____

FUTURE BACTI SAMPLING: BY: OWNER ☐ L.H.D. ☐
OTHER _____ ☐
FREQUENCY: QUARTERLY ☐ ANNUALLY ☐
OTHER _____

WELL RECORD: DATE RECEIVED _____
WATER SUPPLY APPROVED YES ☐ NO ☐ BY _____
DATE _____

COMMENTS: _____

SCALE DRAWING: Make a SCALE DRAWING, including dimensions, in the space provided below. Show well location in respect to all possible sources of contamination, including adjacent property, sewer lines, septic systems, and major sources of contamination. This drawing must be approved by the Health Department. Indicate North.

White -LHD
Canary -MDPH
Pink Copy -Owner
Gold Copy -Owner

D-8 / 10/87
AUTHORITY: Act 399, P.A. 1976

"After well construction is completed, a water well record must be submitted, and the Health Department notified for final inspection and sampling of the well."